Deming and the SPCA

An investigation into the value of Industrial Engineering philosophy

Project Context,
Applications
and Conclusions

by

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Executive Summary

This is an unorthodox project. The purpose of the project is to display the importance of utilizing Industrial Engineering philosophy in the practical application of Industrial Engineering techniques. The purpose of the project will be achieved by solving problems and optimizing processes through using Industrial Engineering techniques while analyzing the effects of various proposed solutions on the greater system.

The project will show that the application of Industrial Engineering techniques to solve problems may in fact produce adverse effects on the greater system if there is a lack of appreciation for the greater system in using these techniques. The results from which conclusions are drawn will not be abstract; conclusions will only be based on empirical evidence. The issue of psychology will be cautiously addressed because it is of too great an importance to Industrial Engineering to be ignored. The method of dealing with matters of psychology is discussed.

The format of the project will be modular – several separate processes will be analysed as opposed to choosing a single problem. Several Industrial Engineering techniques will be employed; the choices of Industrial Engineering techniques utilized being based on the insights provided by the analyses of the processes. The generic method for analysis of processes that will be employed is included under the heading of “Project Scope”.

The development of an Industrial Engineering philosophy is beyond the scope of this project, therefore the Deming Method will be used for reference to Industrial Engineering philosophy. The reasons for choosing the Deming Method are given. In short the aim of this project cannot be achieved without reference to an Industrial Engineering philosophy; therefore since the formulation of an Industrial Engineering philosophy is not within the scope of this project an external philosophy had to be adopted as a rubric. The Deming Method is by no means assumed to be inerrable, it is however a rare example of a generic and complete methodology for the field of Industrial Engineering.

This project must strive to be perfectly objective due to the improvable and contentious nature of much of Deming’s work. A result of this dynamic is that although it is not the aim of the project; the project will take on the form of a contemporary analysis of the practical value of the Deming Method.

Contents

List of figures, lists and tables

Project Context

1. Introductions

1.1 Introduction to this document

This is the first of three introductory sections. This introductory section briefly explains the layout of the entire document. The second introductory section discusses the issue that this project will attempt to confront. The third introductory section is an introduction to the SPCA.

After the introductions a formal definition of the aim of this project is given. Following the aim section is a section titled “Project scope” which explains the scope of this project in depth. Since the scope of this project is dynamic; the scope section includes a complete discussion of the methodology that this project employs.

The scope section is followed by a literature review of the issue which this project attempts to confront. Application specific literature syntheses are included in the relevant sections of the “Applications” segment. The literature review is the final section of the broader “Project Context” segment.

Following the “Project Context” segment is the “Applications” segment of this document. The “Project-modules” section is the first and focal section of the “Applications” segment; which comprises the documentation of the applications of Industrial Engineering tools, methods and techniques of this project. “Other considerations” is the title of the second and final section within the “Applications” segment and covers non-module-specific application considerations.

The third and final segment of this document is the “Conclusions” segment which contains sections titled “Author’s notes” and “References”. The “Author’s notes” section is an informal discussion of general project considerations not included elsewhere within this project. Conclusions based on specific applications are all included within the “Applications” segment.

Descriptions of the appendices and the reasons for inclusion in this document are given in the text when they are originally referred to. All of the appendices are referred to within this document.

1.2 Introduction to the purpose of this project

What is Industrial Engineering? There are several quandaries in answering this question such as the multifaceted nature of the field, the broad spectrum of practical applications and the rapid advancement of technologies used in Industrial Engineering. The issue of defining Industrial Engineering forms an important theme of this project as this project will attempt to confront one of the most poignant difficulties in defining Industrial Engineering – that the definition varies greatly depending on personal opinion.

Job Mail is a career classifieds periodical with an online search. After searching the available jobs for an industrial engineer with a degree the results typically show that approximately 15% of the vacancies are for positions as industrial engineers. The rest of the vacancies are for positions with titles such as

quality control inspector, industrial designer, procurement officer, process engineer, electrical/instrumentation site engineer and plant manager – all of these positions are from the ten results found by Job Mail for vacancies for an industrial engineer in May 2010.

Searches for careers for mechanical, chemical, electrical or civil engineers yield results with diverse names for the various available positions but these well established fields possess an inherent understanding of the field. A mechanical engineer will use applied machine science and a chemical engineer will use applied chemistry. There is little common ground for a procurement officer and a plant manager, or for a procurement officer and a process engineer, or for a process engineer and a plant manager. Therefore the question arises: what is Industrial Engineering considering that industrial engineers have a tenuous professional connection with each other? A hypothesis that will be explored by this project is that Industrial Engineering requires a universal philosophy of application if Industrial Engineering is to be defined as a field with inherent traits in appose to being defined as a result of what industrial engineers do for a living.

New questions now arise: is there not already a universal philosophy that unites industrial engineers as professionals with universally common career attributes? Is it necessary for industrial engineers to have common career attributes? The answers to these questions are desirable outcomes of this project. Hardly a pointless philosophical debate; the essence of the aim of this project is to display the practical value of Industrial Engineering philosophy when Industrial Engineering techniques are employed. Whether or not a tangible benefit can be realized through the application of philosophy remains to be seen, however the literature review attempts to display evidence that it is a reasonable supposition.

Any argument for the necessity of a philosophy in a different engineering discipline is a debate for a different paper, there is however logical inference that the complex nature of Industrial Engineering separates it from the other engineering disciplines in this respect. Ethics is a common engineering issue, but topics such as psychology, politics, supply chain economics and multi-disciplinary engineering are particular to Industrial Engineering.

Since Industrial Engineering is more socially oriented than most of the other established engineering disciplines (because Industrial Engineering involves systems of people), the influence of factors such as the psychology of a workforce is more important than in other engineering disciplines. Psychology is a complex and contentious issue on its own. In designing a system of people (such as a process in a factory) the eventual quality of the system is partly (and often greatly) dependant on the psychology of the people who form part of that system – which is another theme of the literature review. Therefore the psychology of a workforce cannot be ignored if the predictions of the eventual performance of the system are to be trusted. A bridge between psychology and the tools and techniques that currently comprise Industrial Engineering is surely necessary.

Beyond factors for which numbers cannot be applied such as psychology and politics; the literature review attempts to show how much contention exists solely around opinion about how Industrial Engineering tools and techniques are used – the lack of a common philosophy. There exists a myriad of Industrial Engineering techniques that can be applied to improve a system. Simulation analysis, optimization through operations research, elimination of special causes of variation through statistical process control, decision making through probability studies and automation of operations are a few of the more popular Industrial Engineering techniques that undergraduate industrial engineers are exposed to. In addition to techniques that industrial engineers use to improve systems there is a seemingly endless supply of standards and concepts such as Six Sigma, ISO 9000 and the Supply Chain Operations Reference (SCOR) model which industrial engineers institute as a form of quality control.

Contemporary Industrial Engineering also often involves the implementation of new technologies. Installation of new advances in technology for automation, tracking inventory and sharing information requires supervision and planning that often becomes the career of a systems engineer. For example; the installation of enterprise resource planning (ERP) infrastructure in a medium to large company is an extensive and expensive task that is gaining popularity. Constant advancement in both software and hardware used in ERP provides a self-sustaining market for the installation of newer versions by systems engineers.

All of the abovementioned 'tools' might improve systems at varying extents and costs of implementation. It is often more difficult to choose the most appropriate technique and apply it in the most beneficial way than to apply an arbitrary Industrial Engineering technique to improve a system. As well as being able to use an Industrial Engineering technique it is the task and ethical obligation of the industrial engineer to apply expertise objectively in the choice of the Industrial Engineering technique and ensure that it is used properly. It is the display of holistic Industrial Engineering where the improvement of the system is the focus and not the application of a method that will be the aim of this project.

There are discrepancies between Industrial Engineering methodologies. Sadly, although there is a rich diversity and abundance of well documented Industrial Engineering techniques; comprehensive generic philosophies for Industrial Engineering are rare. For example the SCOR 9.0 model explains in great detail how to optimise all individual processes in a supply chain through applying benchmarking and analyzing "best practices". SCOR 9.0 has become popular in industry and is advocated and implemented by many industrial engineers even though the theory of Nash Equilibria suggests that optimizing individual operations separately will not result in optimization of the system. SCOR 9.0 advocates installation of "best practices" determined empirically whereas Deming insisted that to optimise a system best practices should not be a substitute for working on the theory behind the methods that are implemented.

There is thus a dilemma in applying Industrial Engineering techniques – there is dispute over how Industrial Engineering techniques should be applied. To study apposite use of Industrial Engineering techniques objectively there must be theory behind how the Industrial Engineering techniques are applied. One generic and comprehensive system improvement orientated philosophy is the Deming Method.

Prof. Deming passed away in 1993. Since then advances in computing power and the associated development of software for the application and analysis of Industrial Engineering techniques has been profound. Although Deming's work is based on old technology, his philosophies are applicable regardless of changes in technology.

Appendix A is a brief unpublished literature review by the author of this paper that covers the history of operations research. Appendix A was completed as an assignment for the module BOZ321 at the University of Pretoria in 2009. The literature review of appendix A discusses the reasons why Industrial Engineering developed into an amalgamation of techniques in appose to a coherent field of engineering with its own philosophy. Appendix A is included in this paper because it concisely discusses the history of the problem that this project wishes to address. The literature review of section 4 will thus only serve to cover the problem at hand as the history of the problem (the development of Industrial Engineering into a collection of techniques with a weak underlying theory for the application of those tools) is addressed separately. The sentiments contained within the literature review of appendix A are the original motivation for the choice of this project.

1.3 Introduction to the SPCA

The basis for this project is the Tshwane Society for the Prevention of Cruelty to Animals (SPCA).

The Tshwane SPCA (which falls under the auspices of the NSPCA) is a non-profit organization that strives for high ideals in the best interests of all animals within its jurisdiction. Instead of an elaborate paraphrasing, the National Society for the Prevention of Cruelty to Animals (NSPCA) Statement of Policy from the 2010 NSPCA Operations Manual is included in this document as Appendix B. It is doubted that there is any intelligent opposition to the supposition that the goals of the NSPCA and Tshwane SPCA are the epitome of "honorable".

The Tshwane SPCA networks with other societies, but because this project is focused on the operations at their location specifically; from this point in the text onwards the Tshwane SPCA will simply be referred to as the SPCA. Where other branches are mentioned appropriate differentiation will be made. The society as a whole, with all of its individual branches and special units, will be referred to as the NSPCA from this point in the text onwards.

As euthanasia is a phenomenally contentious matter which is UNAVOIDABLY a part of NSPCA operations; it will be discussed here in the introduction. It is the author's personal wish to avoid this issue completely as the ethical considerations of euthanasia are of no relevance to this project. That said; the NSPCA is continually unjustly persecuted as a result of this matter – which necessitates that the author grants special attention to this topic.

Policies and procedures that are even associated with euthanasia will be excluded from this document. Because statistics regarding euthanasia must be excluded (to protect the NSPCA from malicious propaganda), there are numerous other statistics that must be excluded from this project. For example: if the number of arrivals is given then the number of adoptions must be excluded or simple arithmetic would reveal the euthanasia statistics. As is shown in the "Application" segment below, the sensitivity necessary to deal with the issue does not prevent modeling of the system.

Further discussion of the SPCA is included in the "Application" segment where relevant.

2. Project Aim

The aim of this project is to display quantifiable system improvement using Industrial Engineering techniques. Improvement of the system will be the focus of the research as opposed to focusing on how a specific Industrial Engineering technique can be applied to improve a system. Motivation for this approach comes from the teachings of Deming who advocated emphasis on the theory behind a method in oppose to faith in the method itself.

Because of discrepancies within the field of Industrial Engineering regarding the application of techniques; the manner in which the engineering techniques are applied will be a key focus of this project. The Deming Method will be used as rubric for how Industrial Engineering techniques are applied. For the sake of objectivity the Deming method will be scrutinized – the project will therefore take the form of a contemporary analysis of the practical value of the fundamental principles of the Deming Method.

The Deming Method is only one Industrial Engineering philosophy, but this project only requires a single methodology. The literature review attempts to explain the choice of the Deming Method.

In short the aim of this project is to investigate the value of an Industrial Engineering philosophy in the application of Industrial Engineering techniques.

3. Project Scope

This project proposes to analyse a system and use that analysis to aid the selection of an approach to finding a solution. The logic for this approach forms a part of the Deming Method: "Best efforts are essential. Unfortunately, best efforts without the guidance of principles, can do a lot of damage" (Deming, 1982, p. 19). According to the Deming Method lasting positive transformation of a system is only possible when a "system of profound knowledge" is present which includes appreciation for the system. To paraphrase; using an Industrial Engineering technique in order to solve a problem or optimise a subsystem without properly understanding the system will not necessarily benefit the system, especially in the long run.

A result of this proposed approach is that the work that will constitute the project is not predefined. If while analyzing a subsystem the research that is undertaken indicates that optimization of that particular subsystem will not benefit the greater system then the completed research will be registered and analysed but the research will be discontinued. If extra work is deemed to be required then that work will be undertaken. Redundant work will not be completed in the case of research being completed with less effort than anticipated. A consequence of this method is that the project will not be based on a single problem but rather a series of problems that together will showcase and scrutinize the Deming Method.

The Deming Method under scrutiny is the philosophy for Industrial Engineering devised by Prof. W. Edwards Deming. This philosophy is based on the concept of profound knowledge being a requirement in order to devise solutions that provide lasting improvements to a system. To define this methodology it is necessary to understand that it consists of many interdependent and coherent facets that must all be acknowledged in the search for solutions. One summary of profound knowledge is a break down into four parts of this concept (provided by Deming):

Profound knowledge (Deming, 1994, p. 93) consists of:

- Appreciation for a system
- Knowledge about variation
- Theory of knowledge
- Psychology

An example of the application of this theory where an engineering technique is incorrectly used can be found in facilities planning: An industrial engineer may discover that employees in an office environment talk to each other during working hours at the expense of time spent working. A logical and relatively inexpensive solution would be to install cubicles on the office floor to prevent this 'time wastage'. The result would either be that employees must now stand up and move around to talk to one

another or that the employees would become demoralized due to their isolation. A demoralized workforce will not perform as well as a positively motivated workforce. In this case workforce psychology is ignored in devising a solution; to the detriment of the system. An example of the benefit of this knowledge is apparent in the impressive improvements in production that manifested when U-shaped manufacturing layouts replaced straight line layouts in Japan after WWII.

Another example is the possible detriment to a manufacturing department if procurement is cost optimised without appreciation for the effects of a change in quality of raw materials. In this case appreciation for the greater system is ignored in devising a solution; to the detriment of the system.

Although the use of examples is a compromise where sound theory would be better appreciated, it is an unavoidable consequence of summarizing a complex theory in few words. The Deming Method in the context of this project consists of Deming's life's work which can be summarized as the concept that understanding a system and all its dynamics is imperative if one wishes to positively transform that system. Although Deming's work is public domain the project will make reference to his work in order to explain all the methodologies of the project. Because an aspect of the aim of this project is to display the importance of Industrial Engineering philosophy; the project will highlight the adverse effects of applying Industrial Engineering techniques without appreciation for the system at every possible point.

Deming stated that "the most important figures needed for management of any organization are unknown and unknowable" (Deming, 1982, p. 20). Though Deming may theoretically be correct on this account (Deming, 1982, pp. 97-148), the project will by no means be abstract in nature. For the sake of objectivity; conclusions and analysis will all be based on empirical data. The psychology of a workforce is critically important in industry, but there currently exists no means of quantifying the value of psychology in industry with any objective accuracy – therefore regardless of its importance the project will make no attempt to quantify the value of psychology.

There are cases where it seems logical that modifications to a system will result in positive psychological consequences. An example is the use of 200% inspection conducted by separate employees: "200 per cent inspection, as usually carried out, is less reliable than 100 per cent inspection for the simple reason that each inspector depends on the other to do the job. Divided responsibility means that nobody is responsible" (Deming, 1982, p. 30). In such a case the benefit of moving the man-hours of the second inspector to a constructive process is both easily quantifiable and psychologically justifiable.

The analysis of the results of acting on conclusions of the project would obviously be the best measure of the accuracy of the conclusions but this will only be possible if authority to implement the recommendations is provided. The project will therefore be completed under the assumption that there will be no implementation of its recommendations.

The project will analyse several different processes. The amount of detail devoted to a process will depend on results obtained during the analysis. Each process will first be analysed to determine if the process is under statistical control by using the techniques devised by Dr. Walter A. Shewhart. If the process is not under statistical control then an investigation into special causes of variation will be undertaken because the estimated effects of modifications to a system containing special causes of variation will not accurately represent reality: "In the absence of statistical control, no prediction is possible" (Deming, 1994, p. 176). Possible solutions for the elimination of special causes of variation will be explored. The costs of eliminating the special causes of variation will be estimated wherever possible.

The study of the statistical control of the process and possible investigation into special causes of variation will provide an introduction to the process. Once the process is under statistical control the relationship of this process to the greater system will be analysed. Possibilities for improvement of the system will then be explored using insight obtained from research into the relationship between the process and the greater system. Simulation and mathematical modeling will be used at this stage to empirically enumerate the effects of proposed changes to the system. The costs of proposed modifications to the system will be estimated.

If suspected substantial negative psychological effects of a proposed modification are discovered then that proposed modification will not be further explored. Rational explanations of suspected negative effects on the workforce will be presented. If positive psychological effects would logically result from a modification to the system then an explanation of this rationale will be presented. Suspected positive psychological effects on the workforce will play no part in the empirical study. Psychological repercussions with negligible suspected effect will be ignored.

If a process is simulated then either Monte Carlo simulation or simulation with Rockwell Arena 10 simulation software will be used. The type of simulation used will depend on the process and on the reason for the process being modeled. Simulation will only be used if direct mathematical modeling is infeasible. As already mentioned; the choice of Industrial Engineering technique will be explained as this choice is an integral aspect of the project. The method of mathematical modeling employed will depend entirely on what is to be modeled.

It is impossible to plan for creativity but innovative solutions are a desirable outcome of the Deming Method: “it is necessary to innovate” (Deming, 1994, p. 10). Not predefining an Industrial Engineering technique to apply to a process will create a scenario more suited for innovation. The application of new technologies and innovative applications of existing technologies will be considered where relevant. It is beyond the scope of this project to develop a new technology or to explore an innovative idea in excessive depth.

Various Industrial Engineering techniques (including proposed applications of new technologies) will be investigated throughout the project depending of the results of analysis of the system.

After an analysis of a process is completed conclusions based on the investigation of the process will be made. Empirical data obtained from the modeling of proposed modifications will be presented with associated interpretation. For all proposed solutions a reference will be made to the practical value of the Deming Method in that case to highlight the importance of Industrial Engineering philosophy when using Industrial Engineering techniques. Where the Deming Method is proven to be incorrect or lacking by empirical data it will be highlighted and discussed.

Plans for implementation of the recommendations will be included wherever a method of implementation is not self-explanatory.

To define the project scope for the purposes of estimating the eventual size of the project a separate definition for the scope of the completed project is required:

- The project will be coherent and all individual modules will be complete
- The project will display the importance of Industrial Engineering philosophy when applying Industrial Engineering techniques
- The project will reach conclusions on the practical value of the fundamental principles of the Deming Method

4. Literature Review

4.1 The Problem

The most popular definition of Industrial Engineering is provided by the American Institute of Industrial Engineers (Lo & Sculli, 1995):

"Industrial Engineering is concerned with the design, improvement, and installation of integrated systems of men, materials, and equipment. It draws upon specialized knowledge and skills in the mathematical, physical, and social sciences, together with the principles and methods of engineering analysis and design, to specify, predict and evaluate the results to be obtained from such a system."

For anyone familiar with Industrial Engineering the above definition might seem ordinary and reasonable but there is important inference that can be drawn from this particular viewpoint. Social sciences is sighted as a component of the knowledge required by industrial engineers in order to perform their duties even though simulation analysis, optimization through operations research, elimination of special causes of variation through statistical process control, decision making through probability studies and automation of operations can all be completed without any consideration for social dynamics.

Below is a table of Industrial Engineering skills ranked from most to least desirable (Eskandari et al. 2007). The data comes from a 2007 study of undergraduate Industrial Engineering courses obtained by interviewing professionals from the academic community and from industry.

		% of (very) important				
Rank	Desired characteristics	Education	Industry	Others	Combined	Lower bound of CI
1	Adaptable problem-solving skills	100	97	100	*99*	0.93
2	Process evaluation/analyses	98	91	100	*96*	0.90
3	Quantitative/analytical abilities	96	94	100	*96*	0.90
4	Interpersonal skills/presence	96	94	100	*96*	0.90
5	Creative and critical thinking	96	94	–	*95*	0.86
6	Teamwork skills	88	100	95	*93*	0.87
7	Holistic problem solving	93	93	–	*93*	0.83
8	Computer skills	97	81	–	*91*	0.82
9	Decision-making ability	93	88	–	*91*	0.82
10	Technical writing ability	97	75	–	*89*	0.79
11	Project management	88	88	76	*86*	0.79
12	Human dimension of management	69	*87*	86	*78*	0.72
13	Leadership awareness	65	91	76	*75*	0.69
14	General engineering	72	63	–	*69*	0.59
15	Global perspectives	67	50	61	*60*	0.54
16	Diversity sensitivity	69	44	–	*60*	0.51
17	Java or C++ programming	36	13	–	*28*	0.18

Table 1: Desired characteristics of industrial engineers

According to the survey it seems that global perspective is not considered an important trait for an industrial engineer to have. Bearing in mind that global economics (Finnemore, 2006, pp. 54 - 55) and regional politics (Finnemore, 2006, p. 45) form such an important part of the supply chain

management environment (Deming, 1994, p. 2) it stands to reason that a global perspective should be deemed more important.

The human dimension of management is in the bottom half of the table even though the vast majority of systems that industrial engineers work with rely heavily on the performance of the workforce. If a system of people such as on a factory floor is treated without considering the humanity of the blue-collar employees then the repercussions can be severely financially damaging (Finnemore, pp. 268 - 294). As industrial engineers are professionals employed to positively influence the bottom line; surely the human dimension of management should be taken into account regardless of how seemingly removed the employees are from the case in hand. Dealing with the human dimension of management includes long term considerations (Finnemore, pp. 71-73) because employee “motivation, self-esteem, dignity [and] cooperation” change as a function of time (Deming, 1994, p. 122).

Further examination of the table reveals that the three most desirable characteristics of industrial engineers can all be present without “appreciation for a system”, “knowledge about variation”, “theory of knowledge” or “psychology”, which are the four pillars of Deming’s system of profound knowledge (Deming, 1994, p. 93) – without which Deming postulates that sustainable positive system transformation/improvement cannot exist (Deming, 1994, p. 92).

The core of the Deming Method is embodied in point seven on the list of desirable characteristics for industrial engineers to have: holistic problem solving. As is discussed in appendix A; a polarization of Industrial Engineering into distinctly separate theoretical and practical components has occurred as a result of an “under populated area of activity”, “between 'pure theory' (management science) and 'pure practice' (management consulting)” (Corbett and Wassenhove, 1992, p.625). This project proposes that the lack of a connection between the tools and techniques that currently comprise contemporary Industrial Engineering and theory behind the application of the tools and techniques is detrimental but avoidable.

"As an applied science, the work is torn between two objectives: as applied it strives for practical and useful work; as science it seeks increasing understanding of the basic operation, even when the usefulness of this information is not immediately clear", (Flood, 1955).

A theoretically derived philosophy that governs the practice of Industrial Engineering will yield better results than the application of Industrial Engineering methods in the absence of a governing school of thought. There is much empirical evidence for the last statement: Wai-Kwok Lo, 1997; Knouse et al. 2009; Redmond et al., 2008; Finlow-Bates, 2000 and Leitner, 1999 to name a few papers on the subject of the success obtained in applying the Deming Method in Industrial Engineering.

4.2 The Choice of the Deming Method

This project requires an Industrial Engineering philosophy so that the effects of the application of Industrial Engineering tools and techniques without any governing doctrine can be compared to the results obtained when drawing on theory in the application of said tools. Dr. W. Edwards Deming was only a man with an opinion, but his work has many advocates.

Below are the results of a ProQuest web search for articles with “Deming” and either “legacy” or “quality” in the publication’s title from 1 January 1994 to 31 December 2006 as provided by Knouse et al. in their article: “The influence of W. Edwards Deming into the twenty-first century”. Below the table is a graph also from Knouse et. al which displays the information in the table graphically.

Year	Total number of articles	Category		
		Legacy	Application	Basic research
1994	36	31	2	3
1995-1996	30	15	13	2
1997-1998	16	3	12	1
1999-2000	15	12	2	1
2001-2002	5	3	1	1
2003-2004	12	4	6	2
2005-2006	7	0	4	3
Total	121	68	40	13

Table 2: Numbers of articles about Deming

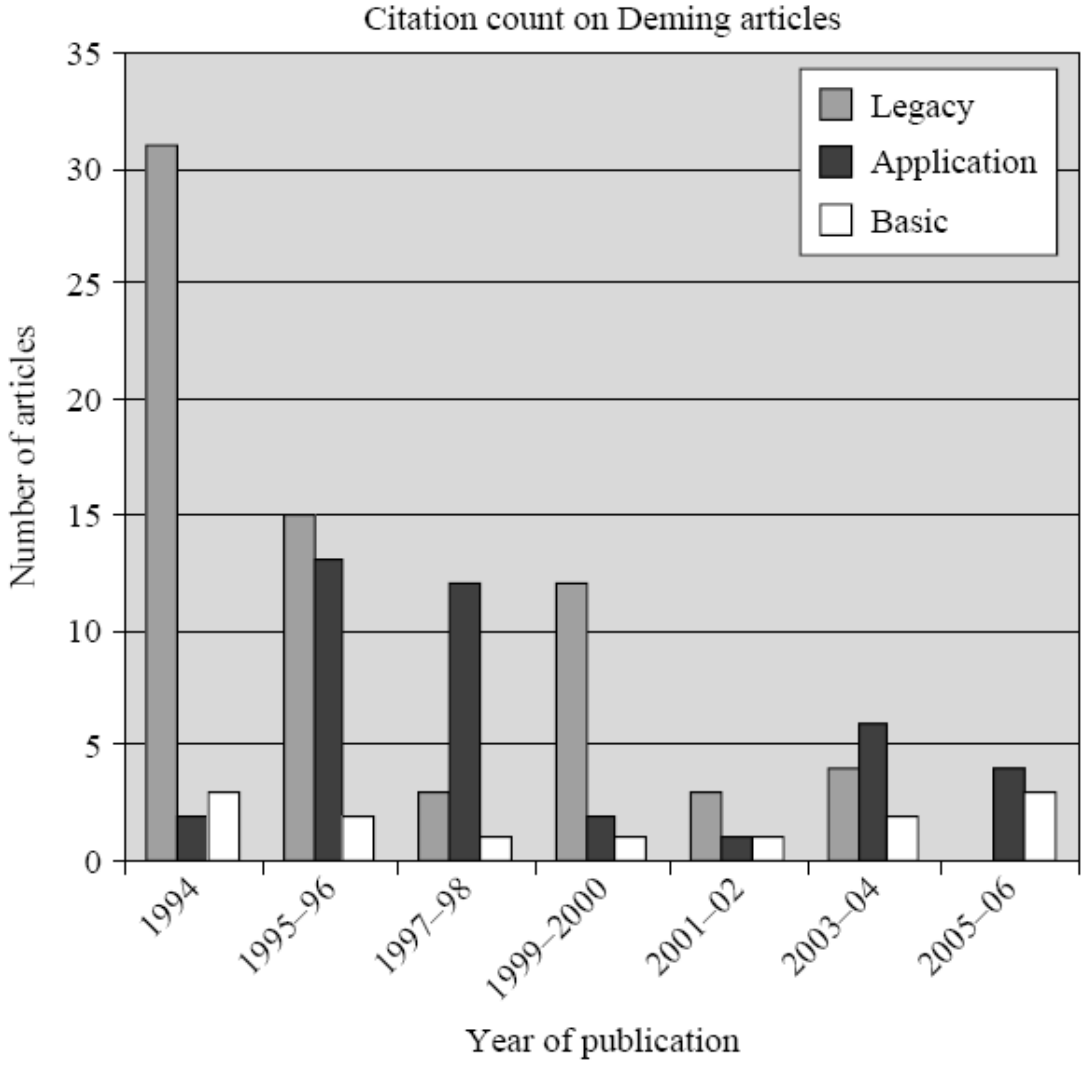


Figure 1: Graph of numbers of articles about Deming

After his death on December 20, 1993 the graph shows that there has been a sporadic decline of publications discussing Deming's legacy. The graph also shows that interest in the concepts devised by Deming and the applications of those concepts has been growing after an initial loss of interest following his death. An Emerald Group Publishing search for journal articles that cite Deming's work revealed that in 2010 alone up until May; 39 articles have been published that cite Deming's work.

There is no doubt that Deming's work was revolutionary and that it has made a remarkable impact on contemporary understanding of systems (Greisler, 1999; Washbush, 2002). There are however other philosophies that can be implemented in the application of Industrial Engineering methods. Below is a comparison of the Deming Method with Taylorism provided by Washbush (2002). Both the Deming Method and Taylorism are complete Industrial Engineering philosophies, although neither is beyond critique.

Thematic areas	Deming's quality management	Taylor's scientific management
General management	Continually provide better products and services	Develop every branch of the business to its highest state of excellence
	Constantly improve production and service processes	Develop every branch of the business to its highest state of excellence
	Put quality first, not short-term profits	Focus on increasing performance, not dividing profits
	Define quality standards in customer terms	Understand quality requirements and teach workers how to do work of the right quality
	Involve everyone in improvement	Share responsibility for making the workplace a success
Management of operations	Design quality into products, services and processes	Plan both good and careful performance into task design
	Understand the meaning in performance variation	Study the work to determine which elements affect performance
	Work to minimize variation and total costs	Continually find better and more reliable methods and practice those methods
	Break down barriers between staff areas	Cooperate with one another
	Eliminate numerical standards and goals	Use standards as benchmarks for testing new methods
Management of people	Educate, train and develop people	Train, help and develop each individual
	Remove barriers that rob people of pride in their work	Eliminate arbitrary management and provide people with the best methods and tools
	Lead and manage with knowledge, not slogans	Manage scientifically
	Drive out fear	Eliminate deliberate underworking caused by the fear of making performance records

Table 3: A comparison of Taylorism and the Deming Method

Taylor's scientific management has supporters (Tolsby, 2000) but scientific management philosophy and the Deming method of management are fundamentally contradictory philosophies (Washbush, 2002). Scientific management suggests that every aspect of business should be optimised whereas the Deming Method encourages the installation of a system of continuous improvement (Deming, 1982, pp. 23). If the case of the contradiction is examined it is clear that Deming's method is more sensible because even if the "one best method" is ever found and implemented; it is only known to be the best method until the parameters of the problem change. In contrast; Deming's concept of constant system improvement facilitates and encourages change. Even modifications to Taylor's work and the development of "neo-Taylorism" have not kept this school of thought from harsh criticism by the likes of Delavigne and Robertson (1994, pp. 24) for being flawed.

Carney and Williams (1997) claim that scientific management does not even exist; instead they suggest that scientific management is a "caricature of science"; a pseudo-philosophy that is nothing more than the application of principles borrowed from classical science and common sense. The problem with Taylorism that arises under this premise is that the "scientific principles" advocated by Taylorism are not necessarily appropriate for implementation in Industrial Engineering. Washbush (2002) lists flaws of Taylorism from numerous sources including the fact that scientific management does not accommodate the human factor in Industrial Engineering. Interestingly; Taylor wished to publish his now famous paper "The Principles of Scientific Management" through the American Society of Mechanical Engineers, which he had served as president, but the ASME refused. In 1911, four years before his death in 1915, Taylor published his paper privately (Dean, 1997).

Taylor's work on efficiency, time and motion study and concepts such as improving the prevailing style of management were a breakthrough in his time and complemented the work of many of the parents of Industrial Engineering such as the Gilbreths (Dean, 1997). Respectfully though, this does not mean that his work provided the best Industrial Engineering philosophy or that it was even correct. Deming (1994, p. 38) states "beware of common sense" and presents numerous examples of the possible adverse effects of relying on common sense in "The New Economics for industry, government, education", Deming W 1994.

The reason for including this harsh appraisal of scientific management in this paper is that without the presence of either sufficient experience or an underlying philosophy: the natural methodology resorted to in the application of Industrial Engineering techniques is Taylorism (Carney and Williams, 1997). Without the external guidance of a school of thought such as the Deming Method; an industrial engineer can only rely on common sense and 'scientific' logic in the application of Industrial Engineering techniques and tools.

The result of not teaching an Industrial Engineering philosophy such as the Deming Method at an undergraduate level is that universities are indirectly preaching Taylorism. For example; if a student is taught linear programming but taught neither the Deming Method nor an alternative philosophy; then that student will rely on personal logic and common sense in choosing what, how and when to use linear programming. The negative aspects of the results of this methodology have already been discussed. Appendix A discusses negative effects that a lack of theory behind the application of techniques is having on the field of Industrial Engineering.

There is Industrial Engineering philosophy besides Taylorism and the Deming Method but complete, relevant, seemingly successful philosophies that can be applied in Industrial Engineering are rare. The Deming Method was not chosen arbitrarily but as this project does not assume that Deming is either right or wrong, the reasons for the choice of this specific methodology are inconsequential. Perhaps the greatest motivation for the choice of the Deming Method can be quoted from the home page of The W. Edwards Deming Institute:

"The W. Edwards Deming Institute® is a nonprofit organization that was founded in 1993 by noted consultant Dr. W. Edwards Deming.

The aim of the Institute is to foster understanding of The Deming System of Profound Knowledge™ to advance commerce, prosperity and peace."

4.3 The Deming Method

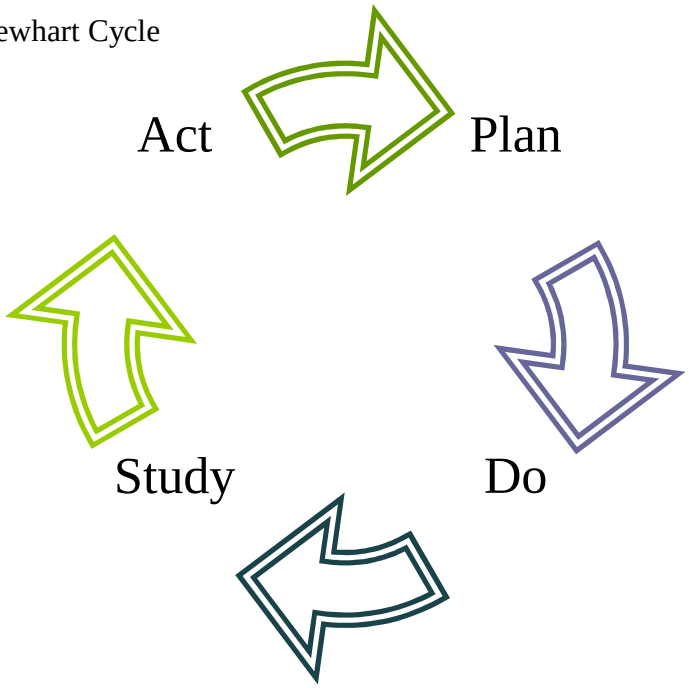
The Deming Method can be summerised by the following three aspects:

- the Shewhart Cycle for learning and improvement (Deming, 1994, p. 132),
- the system of profound knowledge (Deming, 1994, p. 92) and
- Deming's 14 points for management (Deming, 1982, p. 23).

4.3.1 The Shewhart Cycle

Deming formulated the Shewhart Cycle and started teaching it in Japan in 1950 (Deming, 1993, p. 131). Also known as the PSDA Cycle, the Shewhart Cycle is named after Deming's mentor Dr. Walter Andrew Shewhart. The process is carried out and repeated to gain new insight into a product or process.

Figure 2: The Shewhart Cycle



The concept of the PDSA Cycle is simple:

- Step 1: Plan
  - Stage Zero
    Someone has an idea about how to improve a product or process. This is where the cycle is entered.
  - Stage One
    This is the planning stage for either a test, a comparison or an experiment that will explore idea of Stage Zero.

- Step 2: Do
  Perform the test, comparison or experiment that was designed in Step 1

- Step 3: Study
  Analyse and interpret the results of Step 2.

- Step 4: Act
  - Option One
    Implement the proposed improvement to the product or process.
  - Option Two
    Abandon the idea for improvement to the product or process.
  - Option Three
    Repeat the cycle from Step 1 using the information gained from Step 3.

4.3.2 The System of Profound Knowledge

Deming's system of profound knowledge consists of four distinct facets (Deming, 1993, p. 92):

- Appreciation for a system
  This consists of both a general appreciation for system dynamics and an understanding of the system that is under scrutiny.

- Knowledge about variation
  Understanding the concept of variation is important in understanding the outputs of a system or process. Deming's famous funnel experiment (Deming, 1993, p. 190) provides clear examples of how a lack of knowledge of variation can lead to misinterpretation of the outputs of the system. The funnel experiment illustrates that logic and common sense can mislead an industrial engineer into making a detrimental change to the system in the absence of knowledge about variation.

- Theory of knowledge
  Management of a system relies on prediction of the future state of the system; without the theory necessary to facilitate prediction it is impossible to manage that system except by luck (Deming, 1993, p. 101). This point implies that the use of best practices is redundant because without understanding why the "best practice" works elsewhere it is impossible to predict its effect on the system.

- Psychology
  People have a huge impact on systems. If the psychology of the people involved with a system is not accounted for in planning a system modification then the expected results of the modification might be completely wrong (Deming, 1993, p. 107).

Deming's system of profound knowledge is his governing philosophy for the design of lasting positive transformation of a system (Deming, 1993, p. 92). The argument that Deming makes is that a system cannot be transformed without an external perspective of the system – the system of profound knowledge is that external perspective.

"One need not be eminent in any part nor in all four parts in order to understand it and to apply it." – Deming (1993, p. 93) commenting on a system of profound knowledge.

4.3.3 Deming's 14 points for management

Deming (1982, p. 23) published these 14 points with explanations and interpretations in his book, "Out of the Crisis".

1. Constantly seek improvements
2. Adopt the Deming Method
3. Stop dependence on inspection to attain quality
4. Develop mutually beneficial relationships with suppliers
5. Improve quality and productivity constantly forever
6. Institute on-the-job training
7. Substitute supervision with proper leadership
8. Eliminate employee fear
9. Eliminate barriers between departments
10. Eliminate pointless slogans and mottos
11. Eliminate work standards (quotas)
12. Promote pride in workmanship
13. Promote education and mechanisms for self-improvement
14. Get everyone in the organization working toward positive system transformation

4.4 Other contemporary analyses of the practical value of the fundamental principles of the Deming Method

There exist numerous journal articles that cover:

- successful application of the Deming Method in industry,
- interpretation of Deming's work,
- critique of Deming's work and
- the contemporary relevance of Deming's work.

Articles that compare the theory behind different Industrial Engineering philosophies are less common but do exist. Washbush (2002) compares the theory of Taylorism with the theory of the Deming Method as a part of his paper titled "Deming: a new philosophy or another voice?" Washbush's comparison of Taylorism with the Deming Method is extremely close to this project's aim; except that this project seeks to explore empirical evidence whereas Washbush's argument is purely theoretical.

The literature study has indicated that this project might be unique in both its argument for the value of a governing philosophy in the application of tools and techniques of Industrial Engineering; and in its attempt to ratify this argument practically through obtaining empirical data.

Applications

5. Project-modules

5.1 Module 1: The Admission Procedure

When the author first discussed possible project modules with the SPCA they provided the author with a problem statement which was a perfect start to the project for a variety of reasons. The problem statement was that "there are a number of different ways that animals can enter the SPCA care system; the result of which is convoluted administrative procedures pertaining to new arrivals."

Analysis of the admissions procedures is an appropriate starting point for this project for these reasons:

- It avoids euthanasia considerations inherent in many other areas of the SPCA care system.
- It provides a logical starting point for analyzing the animal care process.
- The admissions procedures contain relevant information pertaining to the lengths of time that animals spend in the system before entering the adoption process. This is important for understanding resource management at the SPCA.
- It supplies an overview of most of the system.

5.1.1 Appreciation for the System

In accordance with the Deming Method; before attempting to engineer the SPCA's admissions procedures a comprehensive understanding of the process within the context of the larger system is sought. To accomplish this end visually the current admissions procedures are modeled with Arena 10.0 simulation software.

The information used for building these models is included in appendix C. Appendix C is an extract from an internal SPCA document that was drafted to establish clarity with regard to the general admissions procedures at the SPCA. Appendix C is slightly different from the original document; information beyond animals entering the adoption process and information deemed inappropriate for public publication has been omitted.

The models are too small to read the names of the model elements but following sections explain the model elements, process flows and all necessary information used to find a solution to the problem statement. The images of the simulated model configuration are included here to show the extent of the model of the current standard operating procedures.

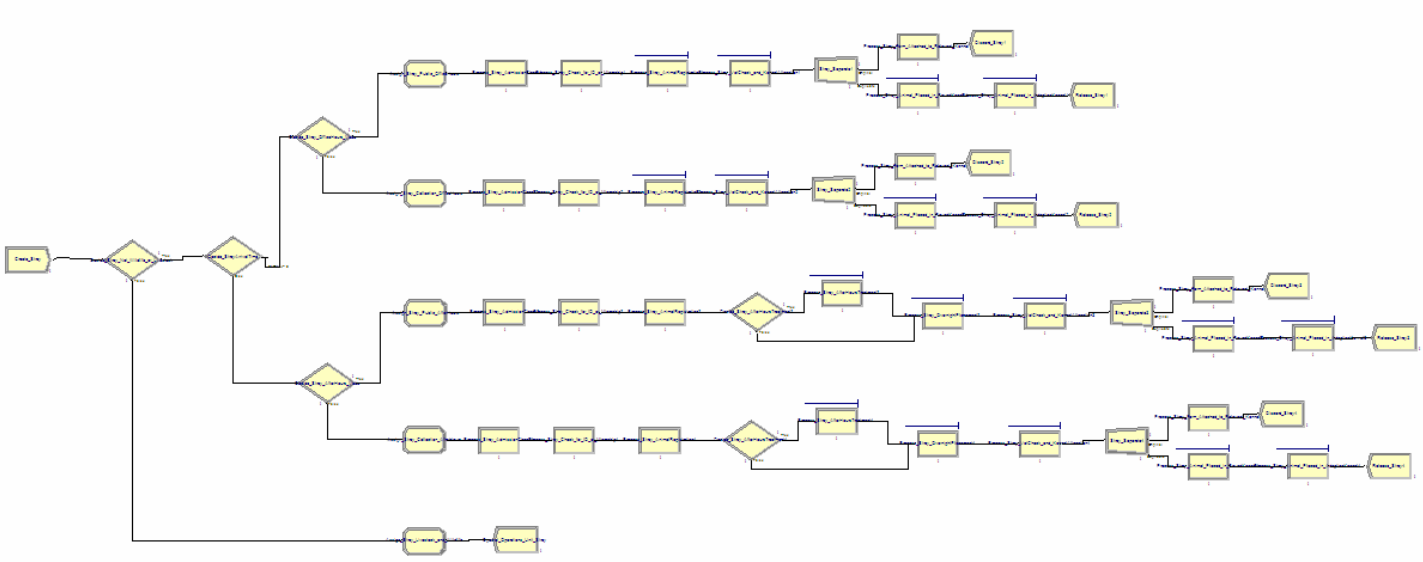


Figure 3: The admissions procedure for strays

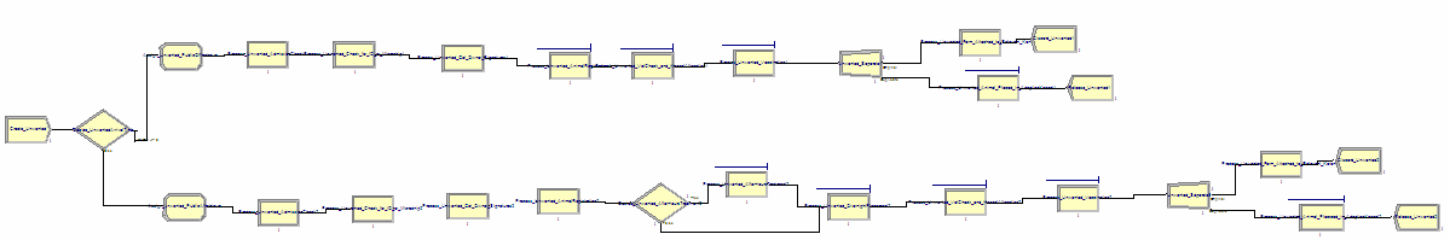


Figure 4: The admissions procedure for unwanted and abandoned animals

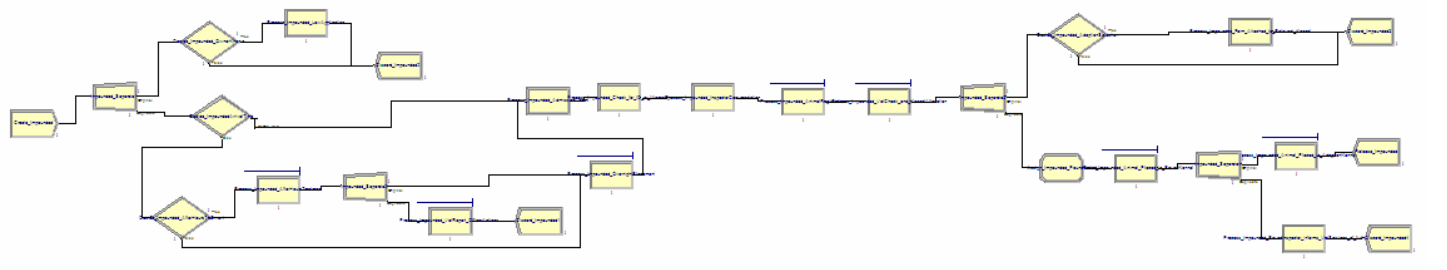


Figure 5: The admissions procedure for impounded animals

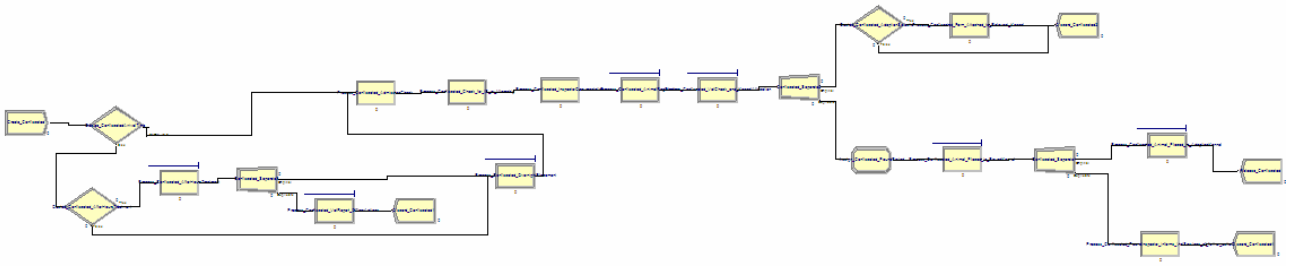


Figure 6: The admissions procedure for confiscated animals

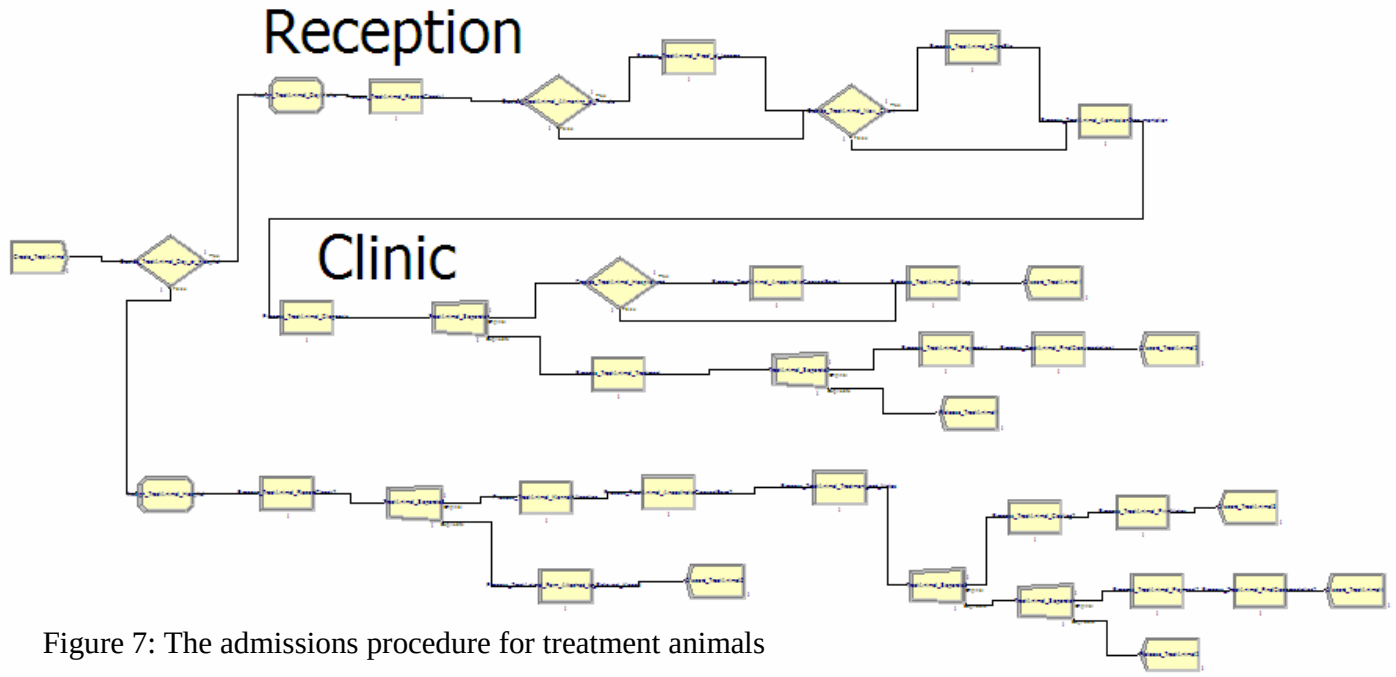


Figure 7: The admissions procedure for treatment animals

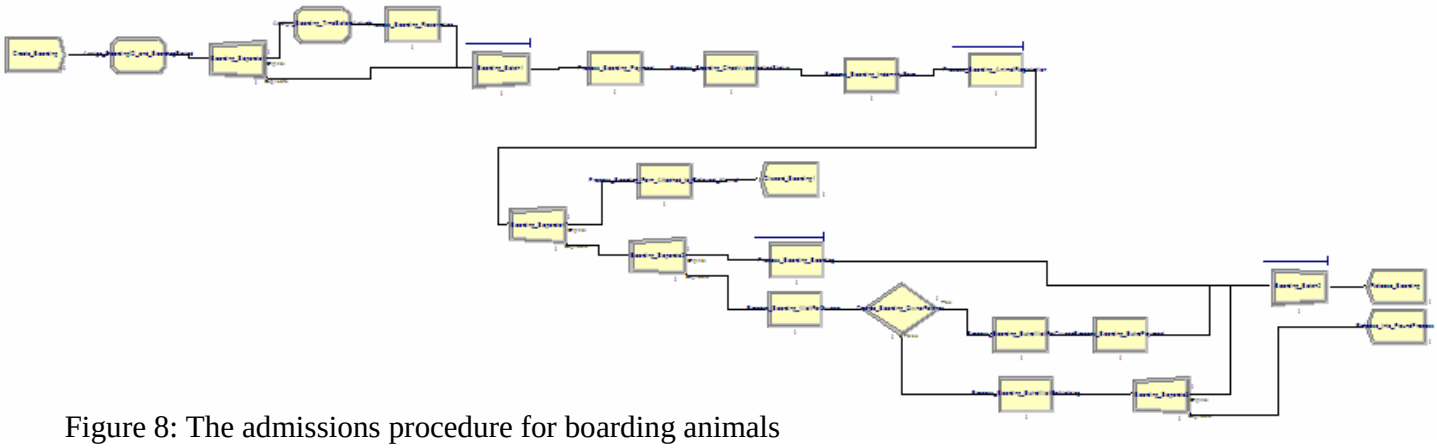


Figure 8: The admissions procedure for boarding animals

5.1.2 Preliminary Analysis

Below are lists of all the processes in the above models. Alone the lists are as meaningless as the above images; further analysis in the following sections will explain the above models. The lists are in alphabetical order instead of sequential order; the reason for this method of looking at the processes is also included in the next section.

The naming format was chosen carefully and is explained in section “5.1.5 Preliminary resolution”.

Processes for Admission of Strays

Process_Stray_AdmissionCheck1
Process_Stray_AdmissionCheck2
Process_Stray_AdmissionCheck3
Process_Stray_AdmissionCheck4

Process_Stray_AfterHoursTreatment3
Process_Stray_AfterHoursTreatment4
Process_Stray_Animal_Placed_in_AdoptionKennel1
Process_Stray_Animal_Placed_in_AdoptionKennel2
Process_Stray_Animal_Placed_in_AdoptionKennel3
Process_Stray_Animal_Placed_in_AdoptionKennel4
Process_Stray_Animal_Placed_in_PoundKennel1
Process_Stray_Animal_Placed_in_PoundKennel2
Process_Stray_Animal_Placed_in_PoundKennel3
Process_Stray_Animal_Placed_in_PoundKennel4
Process_Stray_AnimalRegistration1
Process_Stray_AnimalRegistration2
Process_Stray_AnimalRegistration3
Process_Stray_AnimalRegistration4
Process_Stray_Check_for_ID_or_Microchip1
Process_Stray_Check_for_ID_or_Microchip2
Process_Stray_Check_for_ID_or_Microchip3
Process_Stray_Check_for_ID_or_Microchip4
Process_Stray_Form_Attached_to_Relevant_Kennel1
Process_Stray_Form_Attached_to_Relevant_Kennel2
Process_Stray_Form_Attached_to_Relevant_Kennel3
Process_Stray_Form_Attached_to_Relevant_Kennel4
Process_Stray_OvernightPlacement3
Process_Stray_OvernightPlacement4
Process_Stray_VetCheck_and_KennelAllocation1
Process_Stray_VetCheck_and_KennelAllocation2
Process_Stray_VetCheck_and_KennelAllocation3
Process_Stray_VetCheck_and_KennelAllocation4

List 1: List of processes for admission of strays

Processes for Admission of Unwanted Animals

Process_Unwanted_AdmissionCheck1
Process_Unwanted_AdmissionCheck2
Process_Unwanted_AfterHoursTreatment2
Process_Unwanted_Animal_Placed_in_AdoptionKennel1
Process_Unwanted_Animal_Placed_in_AdoptionKennel2
Process_Unwanted_AnimalRegistration1
Process_Unwanted_AnimalRegistration2
Process_Unwanted_Check_for_ID_or_Microchip1
Process_Unwanted_Check_for_ID_or_Microchip2
Process_Unwanted_Form_Attached_to_Relevant_Kennel1
Process_Unwanted_Form_Attached_to_Relevant_Kennel2
Process_Unwanted_Get_Owner_Signatures1
Process_Unwanted_Get_Owner_Signatures2
Process_Unwanted_OvernightPlacement2
Process_Unwanted_Vaccination1
Process_Unwanted_Vaccination2
Process_Unwanted_VetCheck_and_KennelAllocation1
Process_Unwanted_VetCheck_and_KennelAllocation2

List 2: List of processes for admission of unwanted Animals

Processes for Admission of Impounded Animals

Process_Impounded_AdmissionCheck
Process_Impounded_AfterHoursTreatment
Process_Impounded_Animal_Placed_in_AdoptionKennel
Process_Impounded_Animal_Placed_in_PoundKennel
Process_Impounded_AnimalRegistration
Process_Impounded_Check_for_ID_or_Microchip
Process_Impounded_Form_Attached_to_Relevant_Kennel
Process_Impounded_InspectorDocumentation
Process_Impounded_LawApplication
Process_Impounded_OvernightPlacement
Process_Impounded_PoundInspector_informs_VetServices_of_further_action
Process_Impounded_VetCheck_and_KennelAllocation
Process_Impounded_VetReport_OfficerActions

List 3: List of processes for admission of impounded animals

Processes for Admission of Confiscated Animals

Process_Confiscated_AdmissionCheck
Process_Confiscated_AfterHoursTreatment
Process_Confiscated_Animal_Placed_in_AdoptionKennel
Process_Confiscated_Animal_Placed_in_PoundKennel
Process_Confiscated_AnimalRegistration
Process_Confiscated_Check_for_ID_or_Microchip
Process_Confiscated_Form_Attached_to_Relevant_Kennel
Process_Confiscated_InspectorDocumentation
Process_Confiscated_OvernightPlacement
Process_Confiscated_PoundInspector_informs_VetServices_of_further_action
Process_Confiscated_VetCheck_and_KennelAllocation
Process_Confiscated_VetReport_OfficerActions

List 4: List of processes for admission of confiscated animals

Processes for Admission of Treatment Animals

Process_TreatAnimal_AdmissionDocumentation
Process_TreatAnimal_AnaestheticConsentForm1
Process_TreatAnimal_AnaestheticConsentForm2
Process_TreatAnimal_Costing1
Process_TreatAnimal_Costing2
Process_TreatAnimal_Diagnosis
Process_TreatAnimal_FinalDocumentation1
Process_TreatAnimal_FinalDocumentation2
Process_TreatAnimal_Form_Attached_to_Relevant_Kennel
Process_TreatAnimal_KennelAllocation
Process_TreatAnimal_OpenFile
Process_TreatAnimal_Payment1
Process_TreatAnimal_Payment2
Process_TreatAnimal_PrintNotes
Process_TreatAnimal_Proof_of_Income
Process_TreatAnimal_RecordCheck1

Process_TreatAnimal_RecordCheck2
Process_TreatAnimal_Treatment
Process_TreatAnimal_Treatment_and_Notes

List 5: List of processes for admission of animals for treatment

Processes for Admission of Boarding Animals

Process_Boarding_Boarding
Process_Boarding_CheckVaccinationStatus
Process_Boarding_ExtraPayment
Process_Boarding_ExtraWaitForNothing
Process_Boarding_ExtraWaitForOwners
Process_Boarding_Form_Attached_to_Relevant_Kennel1
Process_Boarding_IndemnityForm
Process_Boarding_Payment
Process_Boarding_Reservation
Process_Boarding_Stray_AnimalRegistration
Process_Boarding_WaitForOwners

List 6: List of processes for admission of boarding animals

In total there are 105 processes in the above model and they are distributed as follows:

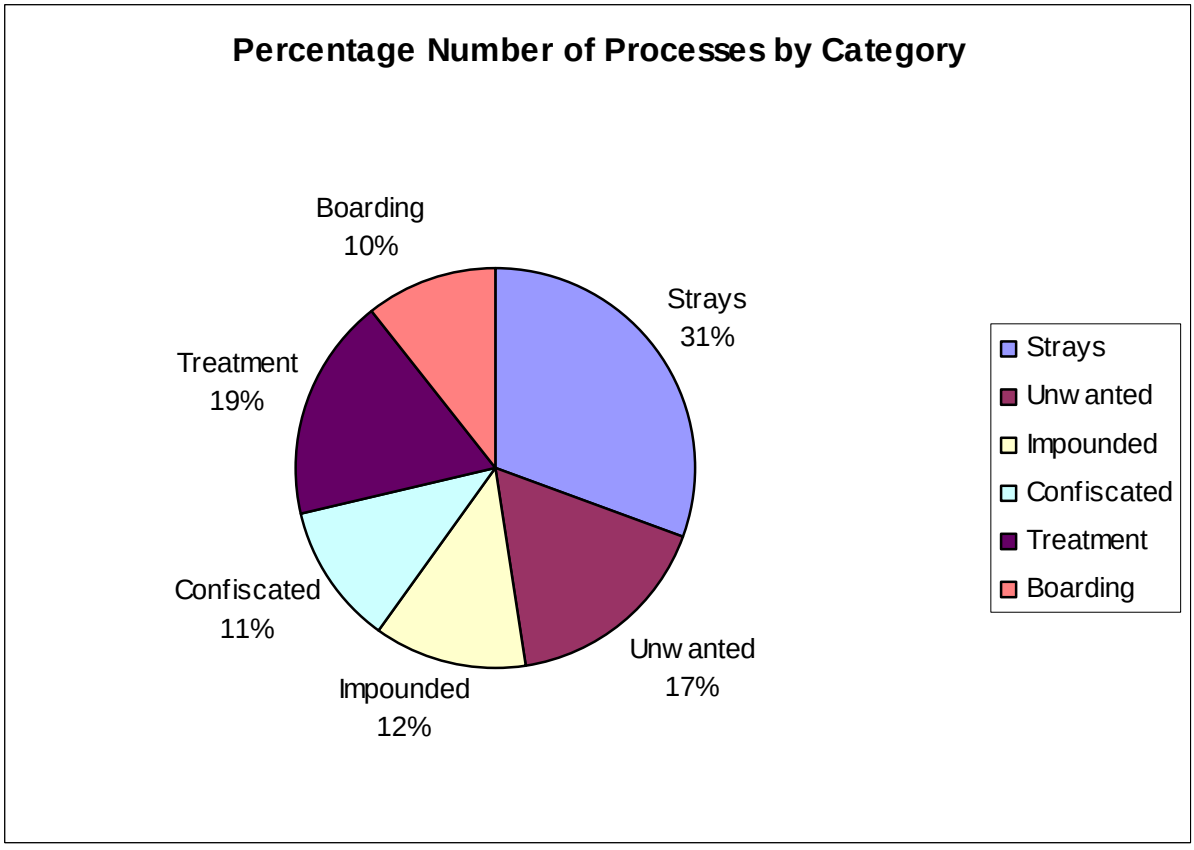


Figure 9: Pie graph of number of processes by category

In the above models there are 19 processes that are repeated. The repetitions of the same basic process are listed in the table below:

A	Unique Processes	17
B	Form_Attached_to_Relevant_Kennel	10
C	AnimalRegistration	9
D	AdmissionCheck	8
E	Animal_Placed_in_AdoptionKennel	8
F	Check_for_ID_or_Microchip	8
G	VetCheck_and_KennelAllocation	8
H	Animal_Placed_in_PoundKennel	6
I	AfterHoursTreatment	5
J	OvernightPlacement	5
K	Payment	3
L	Get_Owner_Signatures	2
M	Vaccination	2
N	InspectorDocumentation	2
O	PoundInspector_informs_VetServices_of_further_action	2
P	VetReport_OfficerActions	2
Q	AnaestheticConsentForm	2
R	Costing	2
S	FinalDocumentation	2
T	RecordCheck	2
		105

Table 4: Table of process repetitions

Below is a bar graph which visually represents the above table of process repetitions:

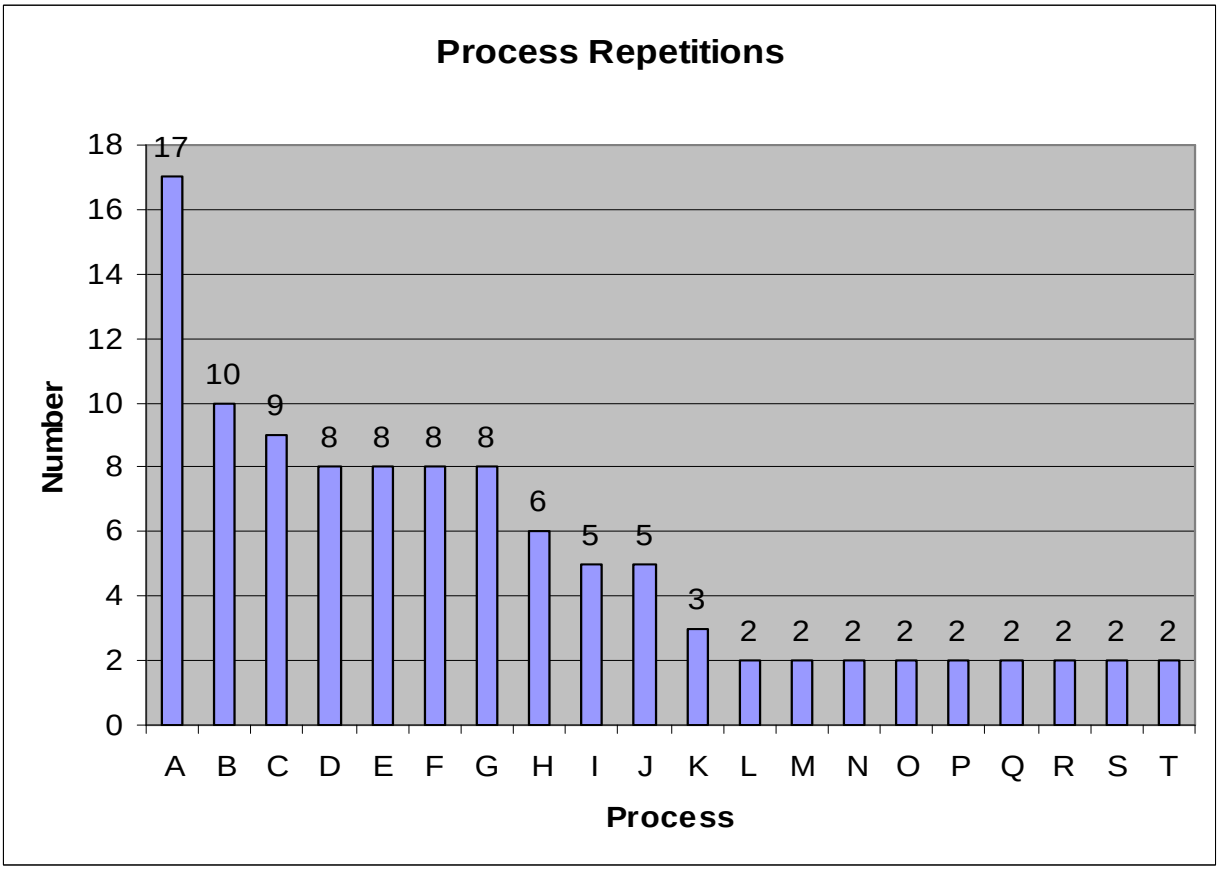


Figure 10: Graph of process repetitions

Appendix D contains a complete list of all the processes in the above model. The processes in the list in appendix D are ordered by process. Appendix D can be considered the secondary source of the information in Table 4 and Figure 10; the primary source being the standard operating procedures for admissions which is included in appendix C.

5.1.3 Analysis

This "problem" is a prime example of the application of best efforts in the interest of the system; which has resulted in a "psychological" problem due to a "lack of appreciation" for the larger system. It is with self-reproach that this statement is made because the current SPCA standard operating procedures document serves the purpose for which it was drafted infallibly. Most of the work has already been done and it is a small step further to remove redundant convolution.

The author of this project interviewed the author of the current SPCA Standard Operating Procedures document (SOP) and discovered that the SOP was originally intended to be a very simple internal reference document for the admission and release of any animal into or out of the SPCA system. The reasoning for this is quite sound: the procedures for admissions and releases are spread out in the 2010 NSPCA Operations Manual; which is too lengthy and contains too much information not related to general admissions and release procedures to be considered a feasible source for this information in day-to-day operations. (The contents pages of the 2010 NSPCA Operations Manual are included in appendix E to illustrate the previous point). Therefore the author of the SOP took the initiative to formally document the admissions and release procedures for each of the different categories of animals that can enter the SPCA system.

The original purpose of the SOP was to explain the admissions and release procedures in such a way that a new staff member would easily be able to use the document for direct reference to the procedure for any category of animal. The obvious way of doing this is to explain the admissions and release procedure for every category of animal from start to finish. The result would be that if an animal of category X must be admitted then a new employee could flip the SOP to the admission procedure for an animal of category X and read the procedure sequentially.

Deming's insistence on an understanding of psychology to provide lasting improvement to a system is hereby vindicated: because the 2010 NSPCA Operations Manual is infeasible for day-to-day reference and there is only a single other available document of procedures; it is logical that the entire workforce involved with these issues will adopt the SOP for day-to-day reference. This has resulted in the SOP being used for a purpose for which it was never intended.

The ramifications of the SOP being so widely adopted have been vast. Although animals entering the system are all subject to very similar procedures due to their inherent traits (a dog is a dog); the administrations staff at the SPCA treat animals of different categories as alien from one another. The result being that there is much repetition of identical processes in the SOP as is evidenced by figure 10 and table 4 above.

5.1.4 The way forward

As mentioned in the previous section; the SOP performs the purpose for which it was drafted infallibly; there is therefore no need to modify it (at least until an analysis of the individual processes has been completed). An additional document is needed to fulfill the role of the SOP where use of the SOP is not appropriate. In the following section the author attempts to simplify the SOP while retaining its exact essence.

5.1.5 Preliminary resolution

As already mentioned; the SOP of appendix C does not correlate exactly to the SOP in use at the SPCA. For example: in appendix C vaccination is only a stated process for unwanted animals; in truth vaccination is a much more common process but is subject to processes and decisions that are undisclosed within this document. This is not an issue that this module has any interest in addressing; specific processes and decision making methods will be discussed in other project modules. The first step towards being able to improve the operations model is to develop a "flawed" model of operating procedures that is easier to work with than the "flawed" model represented in section "5.1.1 Appreciation for the System".

Below is a truth table of process occurrences within process flows. Underneath the truth table is a table of process descriptions. Below the table of process descriptions is a table of process flow descriptions.

	Stray1	Stray2	Stray3	Stray4	Unwanted1	Unwanted2	Impounded	Confiscated	Treatment1	Treatment2	Boarding		Totals
AdmissionCheck	1	1	1	1	1	1	1	1	0	0	0		8
AfterHoursTreatment	0	0	1	1	0	1	1	1	0	0	0		5
Animal_Placed_in_AdoptionKennel	1	1	1	1	1	1	1	1	0	0	0		8
Animal_Placed_in_PoundKennel	1	1	1	1	0	0	1	1	0	0	0		6
AnimalRegistration	1	1	1	1	1	1	1	1	0	0	1		9
Check_for_ID_or_Microchip	1	1	1	1	1	1	1	1	0	0	0		8
Form_Attached_to_Relevant_Kennel	1	1	1	1	1	1	1	1	1		1		10
OvernightPlacement	0	0	1	1	0	1	1	1	0	0	0		5
VetCheck_and_KennelAllocation	1	1	1	1	1	1	1	1	0	0	0		8
Get_Owner_Signatures	0	0	0	0	1	1	0	0	0	0	0		2
Vaccination	0	0	0	0	1	1	0	0	0	0	0		2
InspectorDocumentation	0	0	0	0	0	0	1	1	0	0	0		2
PoundInspector_informs_VetServices_ of_further_action	0	0	0	0	0	0	1	1	0	0	0		2
VetReport_OfficerActions	0	0	0	0	0	0	1	1	0	0	0		2
AnaestheticConsentForm	0	0	0	0	0	0	0	0	1	1	0		2
Costing	0	0	0	0	0	0	0	0	1	1	0		2
FinalDocumentation	0	0	0	0	0	0	0	0	1	1	0		2
Payment	0	0	0	0	0	0	0	0	1	1	1		3
RecordCheck	0	0	0	0	0	0	0	0	1	1	0		2
													88

Unique Processes													
Process_Impounded_LawApplication	0	0	0	0	0	0	1	0	0	0	0		1
Process_TreatAnimal_ AdmissionDocumentation	0	0	0	0	0	0	0	0	1		0		1
Process_TreatAnimal_Diagnosis	0	0	0	0	0	0	0	0	1		0		1
Process_TreatAnimal_KennelAllocation	0	0	0	0	0	0	0	0	1		0		1
Process_TreatAnimal_OpenFile	0	0	0	0	0	0	0	0	1		0		1
Process_TreatAnimal_PrintNotes	0	0	0	0	0	0	0	0	1		0		1
Process_TreatAnimal_Proof_of_Income	0	0	0	0	0	0	0	0	1		0		1
Process_TreatAnimal_Treatment	0	0	0	0	0	0	0	0	1		0		1
Process_TreatAnimal_Treatment_and_Notes	0	0	0	0	0	0	0	0	1		0		1
Process_Boarding_Boarding	0	0	0	0	0	0	0	0	0	0	1		1
Process_Boarding_CheckVaccinationStatus	0	0	0	0	0	0	0	0	0	0	1		1
Process_Boarding_ExtraPayment	0	0	0	0	0	0	0	0	0	0	1		1
Process_Boarding_ExtraWaitForNothing	0	0	0	0	0	0	0	0	0	0	1		1
Process_Boarding_ExtraWaitForOwners	0	0	0	0	0	0	0	0	0	0	1		1
Process_Boarding_IndemnityForm	0	0	0	0	0	0	0	0	0	0	1		1
Process_Boarding_Reservation	0	0	0	0	0	0	0	0	0	0	1		1
Process_Boarding_WaitForOwners	0	0	0	0	0	0	0	0	0	0	1		1
													17
													105

Table 5: Complete non-sequential truth table of process occurrences within process flows

Process	**Brief Explanation (According to current understanding)**	**Personnel**
AdmissionCheck	When the animal first enters the system and it is decided what should happen e.g. What category the animal belongs to, whether immediate veterinary attention is required and what forms need to be processed first.	Admin
AfterHoursTreatment	After-hours veterinary attention (only occurs if immediate treatment is required when an animal is admitted after-hours).	Vet
Animal_Placed_in_AdoptionKennel	Animal seizes a kennel resource within the adoption process.	-
Animal_Placed_in_PoundKennel	Animal seizes a kennel resource within the pound process.	-
AnimalRegistration	Relevant admissions forms are completed and filed; a record of the admission is entered into the database.	-
Check_for_ID_or_Microchip	An animal is checked for an existing RFID or ID tag.	-
Form_Attached_to_Relevant_Kennel	Relevant forms are attached to the relevant animal's kennel	-
OvernightPlacement	When an animal enters the system after-hours and it is placed into a holding kennel until office-hours start again.	-
-	-	-

VetCheck_and_KennelAllocation	A veterinarian completes a medical examination of an animal and allocates a kennel for it.	Vet
Get_Owner_Signatures	The owner of an animal must sign certain forms before the process flow can continue.	Admin
Vaccination	Animal is vaccinated in accordance with stipulations in the 2010 NSPCA Operations Manual	Vet
InspectorDocumentation	SPCA inspector completes relevant documentation.	SPCA Inspector
PoundInspector_informs_VetServices_ of_further_action	Pound inspector communicates relevant information to the veterinary services department.	Pound Inspector
VetReport_OfficerActions	If an animal entering the system after-hours requires immediate veterinary attention then the attending veterinarian is obligated to file a report interpreting the action of the on-duty admissions officer.	Vet
AnaestheticConsentForm	The owner of an animal completes and signs a form that grants permission to veterinarians to administer anaesthetic to the animal.	Admin
Costing	A fee payable to the SPCA for services rendered is calculated.	Vet
FinalDocumentation	Relevant notes are compiled before the release of the animal from the system.	Vet
Payment	Compensation for services rendered is collected from the relevant parties	Admin
RecordCheck	The animal's history with the SPCA is checked to determine whether the involvement of the SPCA inspectorate is required.	Admin
Unique processes		
Process_Impounded_LawApplication	If an animal is impounded in the execution of legal proceedings then all relevant legislation must be adhered to; including the deduction of the mandatory impoundment period.	-
Process_TreatAnimal_ AdmissionDocumentation	Animal registration process that is unique to admission of animals brought to the SPCA solely for treatment.	Admin
Process_TreatAnimal_Diagnosis	Veterinarian conducts a medical examination of an animal and determines a course of action	Vet
Process_TreatAnimal_KennelAllocation	Animal admitted solely for treatment is placed in a kennel.	-
Process_TreatAnimal_OpenFile	If the animal brought to the SPCA for treatment is brought by a new client then the client must open a new client file.	Admin

Process_TreatAnimal_PrintNotes	Notes made by the veterinarian are printed out for the client.	-
Process_TreatAnimal_Proof_of_Income	Client provides proof of income.	Admin
Process_TreatAnimal_Treatment	An animal that is not hospitalized is treated by the veterinarian.	Vet
Process_TreatAnimal_Treatment_and_Notes	An animal that is hospitalized is treated by the veterinarian; the veterinarian makes relevant notes regarding the treatment.	Vet
Process_Boarding_Boarding	An animal brought to the SPCA for boarding is placed in a kennel for the boarding period.	-
Process_Boarding_CheckVaccinationStatus	The vaccination status of an animal is established.	-
Process_Boarding_ExtraPayment	If an animal brought to the SPCA for boarding is kept in boarding for longer than the arranged time-period then payment for the extra boarding period must be collected.	Admin
Process_Boarding_ExtraWaitForNothing	Time lapse. Owner does not return to collect the boarding animal.	-
Process_Boarding_ExtraWaitForOwners	Time lapse. Owner does not return to collect the boarding animal on time.	-
Process_Boarding_IndemnityForm	Client completes the indemnity form required for the boarding service.	Admin
Process_Boarding_Reservation	Time lapse. Time between reservation of a kennel for boarding and the commencement of the boarding process.	Admin
Process_Boarding_WaitForOwners	Time lapse. Period of prearranged boarding period.	-

Table 6: Table of process descriptions

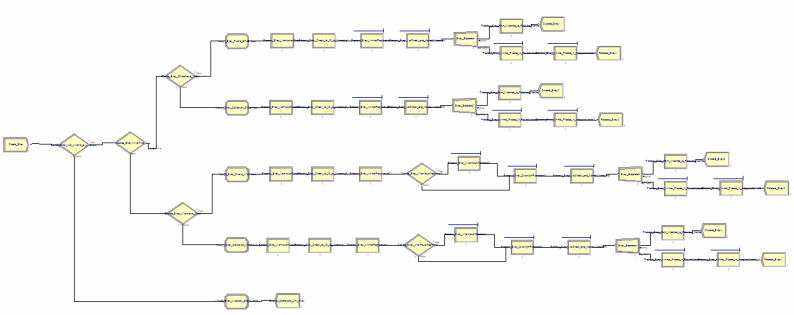
Process flow	**Description**
Strays 1	A stray is brought to the SPCA by a member of the public during office hours.
Strays 2	A stray is collected by SPCA personnel and brought to the SPCA during office hours.
Strays 3	A stray is brought to the SPCA by a member of the public after office hours.
Strays 4	A stray is collected by SPCA personnel and brought to the SPCA after office hours.
Unwanted 1	An unwanted animal is brought to the SPCA by a member of the public during office hours.
Unwanted 2	An abandoned/unwanted animal is collected by SPCA personnel and brought to the SPCA during office hours.
Impounded	For whatever reason, an animal is admitted directly into the pound process.
Confiscated	A confiscated animal enters the system with its relevant process flow.
Treatment 1	An animal is brought to the SPCA to receive treatment as an out patient.
Treatment 2	An animal is brought to the SPCA to receive treatment and must be hospitalized.
Boarding	An animal is brought to the SPCA to enter and leave the SPCA's boarding service.

Table 7: Table of process flow descriptions

The information conveyed in the above three tables should finally make sense of the data in:

- the figures of the model configurations in section “5.1.1 Appreciation for the System”,
- the lists of processes in section “5.1.2 Preliminary Analysis” and
- the list of processes in appendix D.

The naming format for the processes was chosen to relate the process to its corresponding process flow. For example we can look at “figure 3: The admissions procedure for strays” again. There are five distinct process flows which are named from top to bottom strays1, strays2, strays3 and strays4. The fifth process flow indicates that “livestock and wildlife” are immediately referred to the “Special Operations Unit”; as is stipulated in the SOP extract of appendix C.



The same can be said for the figures of the simulations of arrivals of unwanted animals and animals admitted solely for treatment. For animals admitted solely for treatment the first process flow is separated into “Reception” and “Clinic” procedures in the SOP, which is clearly visible in “Figure 7: The admissions procedure for treatment animals”. Impounded, confiscated and boarding animals have a single process flow which is also clearly visible in their respective graphical representations.

The truth table of the process model (table 5) provides a pseudo-graphic illustration of the logical way forward. Up to this point the author of this project faced a conundrum as to the method in which to divide the categories into process flows. One of the contemplated methods was to use a dynamic programming model to minimize process repetitions. The problem with the method would have been that configuring the model to accommodate sequence considerations and flow divergences and convergences would have been a chore of considerable magnitude. The truth table clearly indicates that the admissions procedures for treatment and boarding animals are considerably different to that of stray, unwanted, confiscated and impounded animals.

In accordance with the Deming method; common sense must be observed as dangerous. Sound theory must be developed to ensure that a grievous mistake is not unwittingly being made. Fortunately the quest for appreciation of the system has indicated a possible way forward. Under suspicion gained from appreciation for the system that there is a key underlying difference between:

- Boarding and treatment,
- stay, unwanted/abandoned, confiscated and impounded animals;

one can attempt to discover a theoretical difference between these categories. The difference is clear: after admittance treatment and boarding animals are expected to be released back to their owners whereas it is uncertain how strays, unwanted/abandoned, confiscated and impounded animals will eventually leave the system. An empirically and theoretically justified separation of process flows has been discovered.

5.1.6 Resolution

Documentation for design development of a proposed standard operating procedures document begins here.

Established process flow separations:

- boarding and treatment (from this point on referred to as “visitors”) and
- stray, unwanted/abandoned, confiscated and impounded animals (from this point on referred to as “occupants”).

Proposed process flow divisions:
Although it is only for simplification purposes; the admissions procedure process flows can logically be broken down into four distinct sequential stages which are described in the following table:

Division	Description
Stage 0	This stage constitutes the period prior to any animal being formally allocated a kennel at the SPCA. Visitors never leave stage 0.
Stage 1	Animal is placed in the pound for a period predetermined by NSPCA policy.
Stage 2	Animal is placed in the pound for a grace period in the best interest of the animal.
Stage 3	Animal enters the adoption process.

Table 8: Table of process flow division descriptions

An animal must enter the system at Stage 0. Although an animal can “skip” stages according to NSPCA policy; the divisions are sequential in nature: an animal will not enter a prior stage after entering a latter stage.

At this juncture in the resolution of the problem a non-technical graphic representation of Stage 0 of the current standard operating procedures has been modeled. An explanation follows the figures.

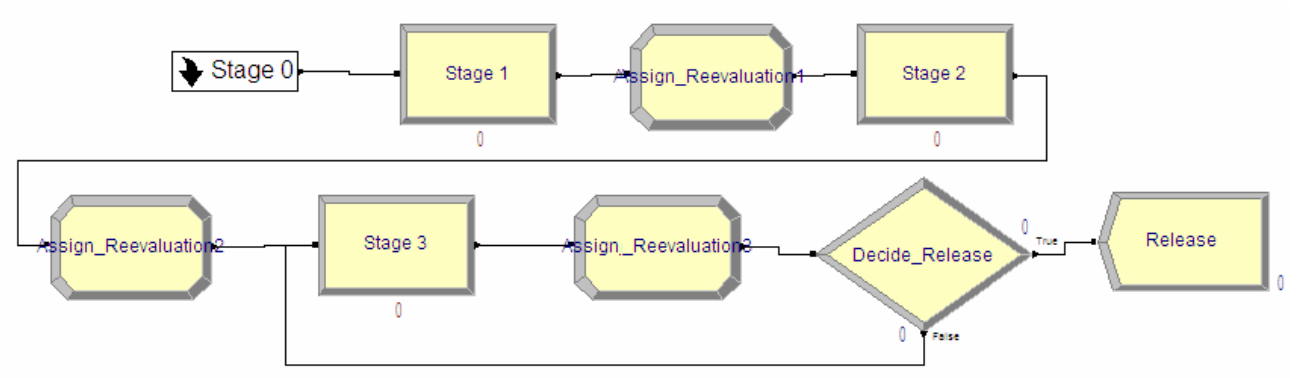


Figure 11: Top level system overview

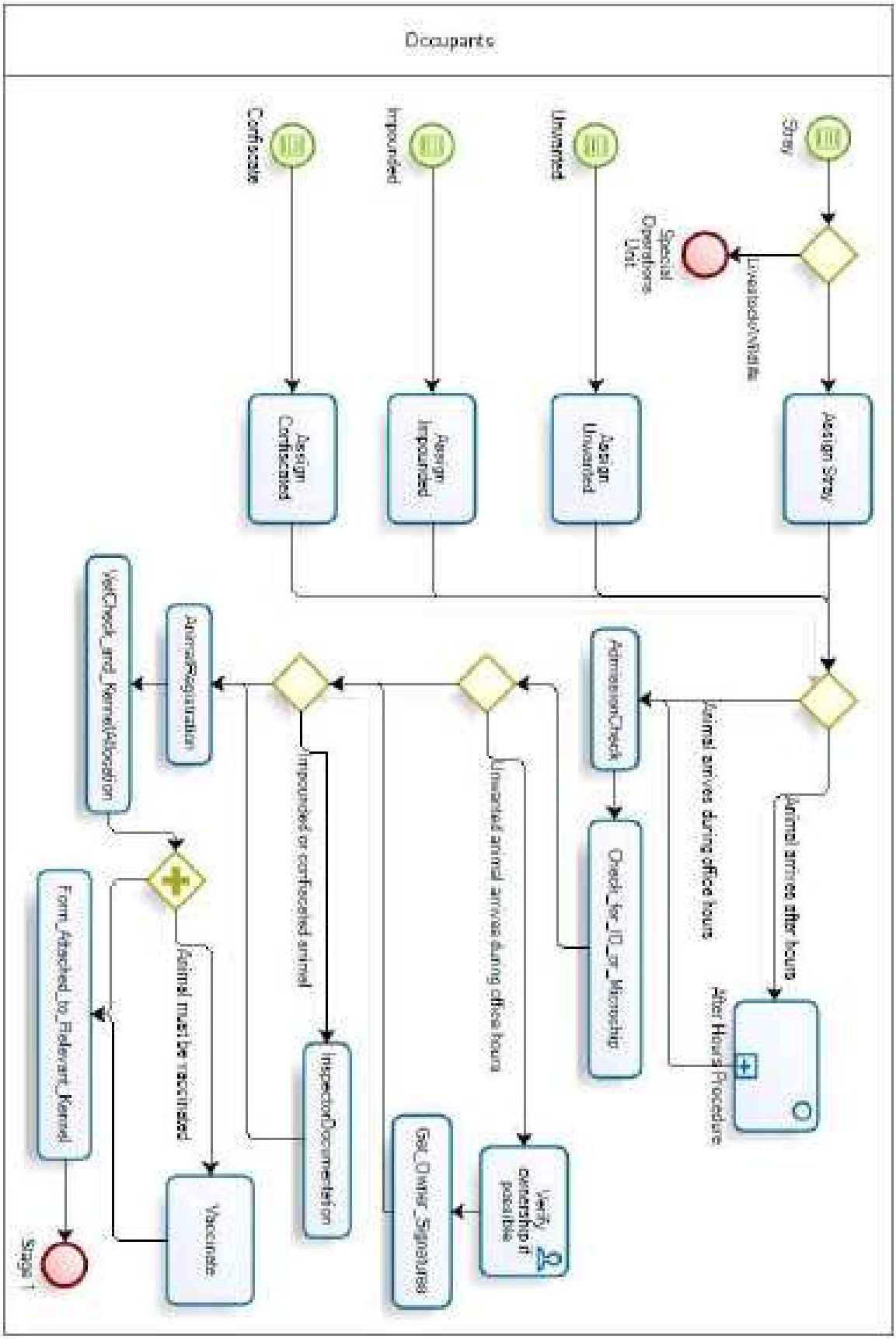


Figure 12: Non-technical Stage 0 for occupants

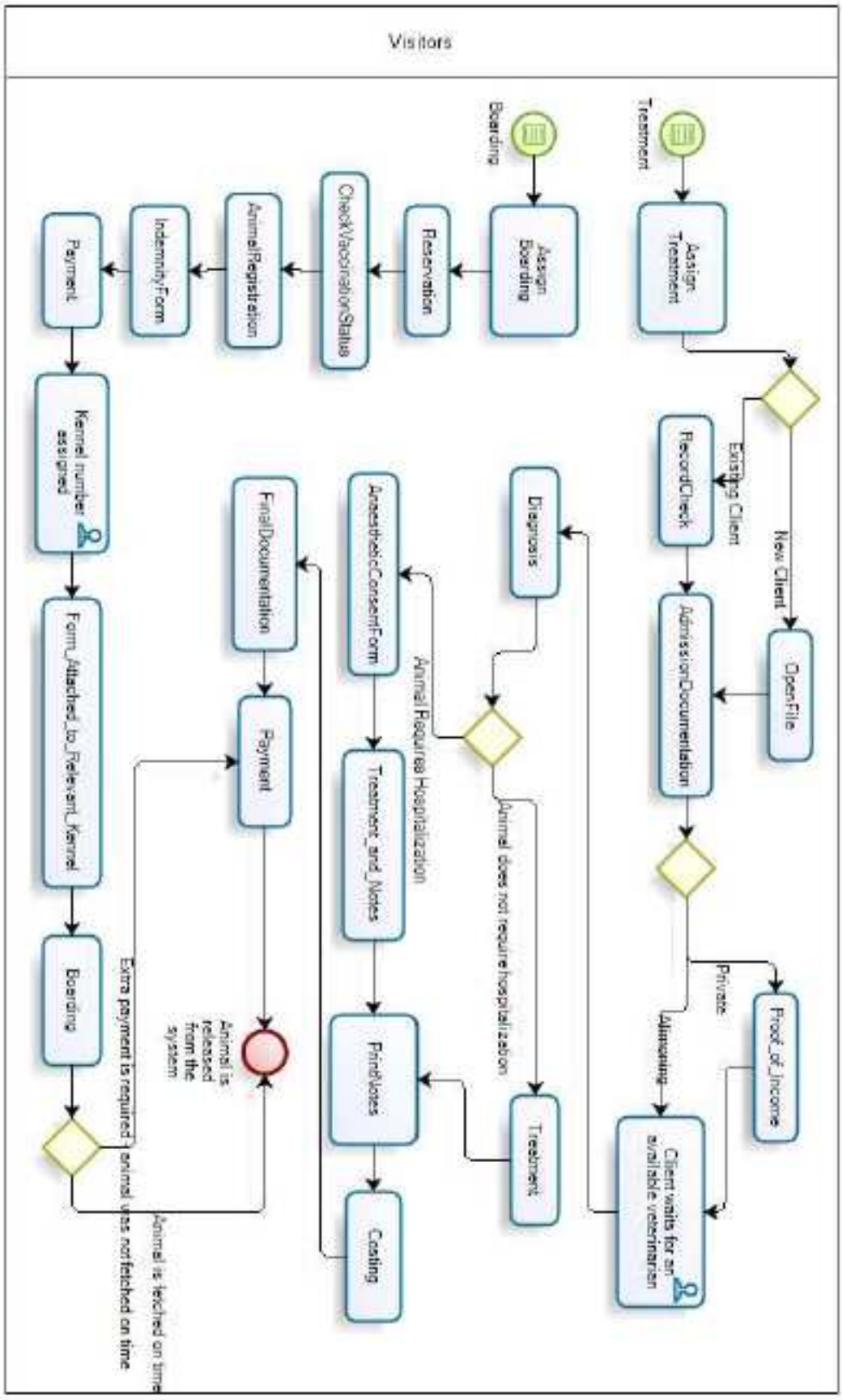


Figure 13: Non-technical Stage 0 for visitors

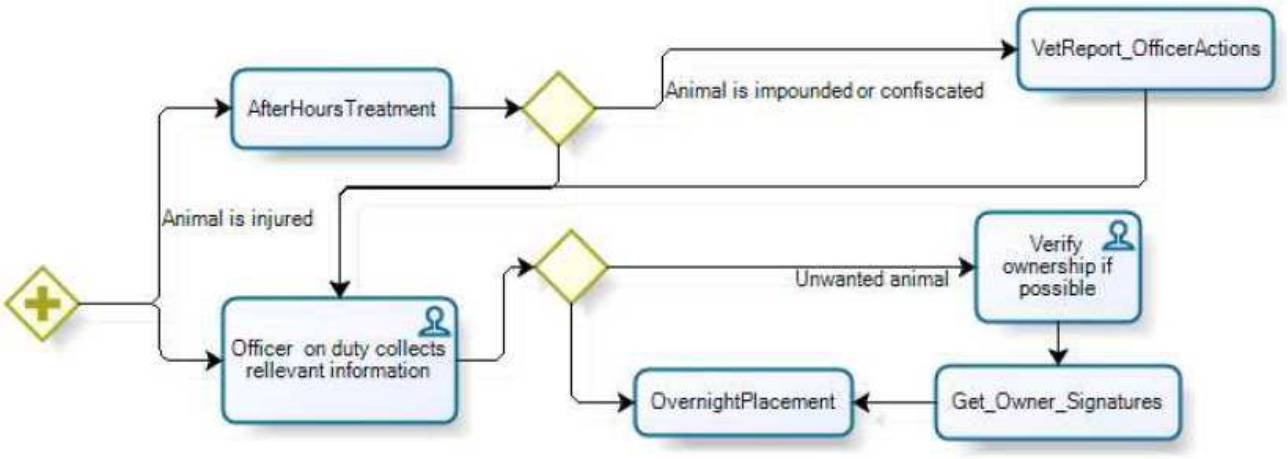


Figure 14: Non-technical sub-procedure for after hour's routine

The non-technical diagrams were modeled with Bizagi Process Modeler version 1.5.1.5. These diagrams have been fabricated as a part of the requirements engineering process: they are less convoluted than functioning technical Arena 10.0 models and as such are more appropriate for illustrative purposes. The value of this gain in procedural transparency is expected to manifest during discussions with the SPCA over a revision of the SOP itself (at this stage it is still only the SOP document that is under scrutiny).

Bizagi diagram notes:

- Rectangles represent processes.
- Processes with a silhouette of a bust are processes which were not included in "Table 6: Table of process descriptions" because they are self-evident and/or of negligible consequence for a simulation. For the sake of completeness they are included in the non-technical diagrams.
- A diamond is a decision, a blank diamond is a decision with mutually exclusive consequent flow paths and a diamond with a cross is a decision that can have simultaneous parallel consequent flow paths.
- A green circle is an initiation of a process flow (in all above cases: an animal entering Stage 0).
- A red circle is a process flow terminator.
- The six "assign" processes refer to the determination of what category an animal entering Stage 0 belongs to.

5.1.7 Solution

What follows is a textual rearrangement of the existing standard operating procedures for admission of occupants; identical in content to the original SOP. The terms in brackets relate the processes to their equivalents contained within "Table 6: Table of process descriptions."

1. An animal arrives at the SPCA.

Stage 0: Before kennel allocation:

2. If the animal falls under the category of "Livestock/Wildlife" then it is immediately referred to the "Special Operations Unit".

After hours procedure

3. If the animal is injured then it must receive veterinary care immediately. (AfterHoursTreatment)
4. If an impounded or confiscated animal is treated after hours then the veterinarian who is on duty must submit a report construing the action of the on-duty admissions officer. (VetReport_OfficerActions)
5. The on duty officer must collect relevant information from whoever brings the animal to the SPCA, especially if the animal is delivered by a member of the public because that might be the last contact that the SPCA has with that person/party. (AnimalRegistration)
6. If an unwanted animal is brought to the SPCA after hours then the on duty officer must verify ownership of the animal if possible and
7. get the owner's signatures. (Get_Owner_Signatures)
8. The animal is then placed in a holding kennel until the next morning (OvernightPlacement)

Office hours procedure

9. The animal is checked at the admission point and it is determined what category the animal belongs to. (AdmissionCheck)
10. The animal is checked for an ID tag or a microchip. (Check_for_ID_or_Microchip)
11. If an unwanted animal is delivered to the SPCA during office hours then the staff member handling the admission of the animal must verify ownership of the animal if possible and
12. get the owner's signatures; the same as for an after hours arrival of an unwanted animal. (Get_Owner_Signatures)
13. If the animal is impounded or confiscated then the inspector's documentation must be compiled and collected. (InspectorDocumentation)
14. The animal's details are collected and entered into the information system. (AnimalRegistration)
15. A veterinarian checks the animal's health and allocates a kennel for it. (VetCheck_and_KennelAllocation)
16. If the animal must be vaccinated then it is vaccinated. (Vaccination)
17. The animal's "form" is attached to the kennel that was allocated to it. (Form_Attached_to_Relevant_Kennel)

Stage 1:

18. The animal is kept in the pound for a predefined non-negotiable period of time (Animal_Placed_in_PoundKennel, PoundInspector_informs_VetServices_of_further_action, LawApplication):

Animal Category	**Stage 1 period**
Stray animals	7 days
Impounded animals	Defined through by-laws
Confiscated animals	Defined through by-laws
Other animals	0 days

Table 9: Table of "Stage 1" periods according to category

Stage 2:

19. The animal is kept in the pound for an optional and negotiable period of time that may be subjectively adjusted at any stage.

Stage 3:

20. The animal enters the adoption process. (Animal_Placed_in_AdoptionKennel)

What follows is a textual rearrangement of the existing standard operating procedure for admission of visitors; identical in content to the original SOP. The terms in brackets relate the processes to their equivalents contained within "Table 6: Table of process descriptions."

Boarding animals: before the animal arrives at the SPCA:

1. A reservation is made for a boarding kennel. (Reservation)

Boarding animals: after the animal arrives at the SPCA:

2. The vaccination status of the animal is checked. (CheckVaccinationStatus)
3. The animal's details are recorded and registered into the information system. (AnimalRegistration)
4. The owner of the animal must complete an indemnity form. (IndemnityForm)
5. Payment for the entire reserved boarding period is collected before boarding starts. (Payment)
6. The animal is assigned a kennel number. (KennelAllocation)
7. The animal's "form" is attached to the kennel that was assigned to it. (Form_Attached_to_Relevant_Kennel)
8. The animal boards at the SPCA. (Boarding)
9. If the animal boards for longer than the originally agreed boarding period then extra payment is collected from the owner. (ExtraPayment)
10. The animal can leave the boarding process in one of two ways:
    a. The owner collects the animal (WaitForOwners, ExtraWaitForOwners) or
    b. The owner does not collect the animal; in which case it is admitted as an unwanted animal at stage 0. (ExtraWaitForNothing)

Treatment animals:

1. If the client is new then a file must be opened for that client. (OpenFile)
2. If an existing client brings an animal to the SPCA for treatment then that client's record must be checked. (RecordCheck)
3. Admission documentation must be completed. (AdmissionDocumentation)
4. If the owner of the animal is expected to pay for the treatment of the animal then proof of income must be collected. (Proof_of_Income)
5. The client waits in the clinic reception for a consultation with an available veterinarian.
6. A veterinarian diagnoses the animal. (Diagnosis)
7. If the animal does not require hospitalization then it is treated. (Treatment)

Animal requires hospitalization:

8. An anaesthetic consent form must be completed. (AnaestheticConsentForm)
9. The animal is treated and notes are made regarding the treatment. (Treatment_and_Notes)

Final duties

10. Notes concerning the treatment of the animal are printed out. (PrintNotes)
11. The cost of the treatment and/or hospitalization is determined. (Costing)
12. Final documentation is completed. (FinalDocumentation)
13. Payment is collected from the owner of the animal before it is discharged. (Payment)

5.1.8 Conclusion A

The problem statement was incorrectly formulated because the cause of the problem was not understood. An attempt to establish a system of profound knowledge (Deming, 1994, p.92) made it possible to understand the cause of the problem and develop a solution for it.

The problem statement was that "there are a number of different ways that animals can enter the SPCA care system; the result of which is convoluted administrative procedures pertaining to new arrivals." Section "5.1.7 Solution" has proved this to be a fallacy by retaining the existing admissions categories while drastically simplifying the admissions procedure. There are 41 processes in section "5.1.7 Solution" that correspond to the processes in "Table 6: Table of process descriptions" as opposed to the original 105 processes contained within "Appendix D: Complete process list for original admissions SOP". The number of processes has been reduced by 61%. The number of process flows has been reduced by 73% (from 11 to 3).

The 61% and 73% reductions are calculated in an attempt to quantify the success of the solution. That said; the true success or failure of the solution can only be measured in unquantifiable psychological terms. The SOP has not been changed at all; only the SOP document. Although more details are included in "Appendix C: Standard Operating Procedures for Admissions" than in "5.1.7 Solution", the reader is encouraged to observe the (subjective) difference in ease of understanding the admissions system between the two documents that has arisen solely through reordering the processes into redefined process flows.

Analysis of the Deming Method:

The problem statement was incorrect because of appreciation for the system and psychological considerations being neglected (Deming, 1994, p. 93).

Lack of appreciation for the system:
The original SOP is not convoluted because of the number of different ways that an animal can enter the SPCA care system; it is repetitive to the point of complexity because of how the process flows of the SOP were chosen. Appreciation for the system gained through analyses indicated that process flows could be chosen differently to simplify the SOP. An active attempt to appreciate the system made the cause of the problem apparent.

Neglect of psychology:
The original process flows illustrated in section "5.1.1 Appreciation for the System" are appropriate for training but not for everyday reference as is explained in section "5.1.3 Analysis". The problem statement itself is a clear indication of how the choices of process flows in the original SOP have been universally adopted at the SPCA. Understanding that the problem of the SOP seeming convoluted was due to psychological considerations being neglected led to the physical solution of manipulating purely metaphysical process flows.

5.1.8 Conclusion B

Appreciation for the system reduced the workload of finding a solution to the problem.

In section “5.1.4 The way forward” it is unwittingly implied that the process flows of the original SOP document had to be restructured. The method of restructuring the process flows was discovered by compiling the truth table of section “5.1.5 Preliminary resolution”. Without the appreciation for the system gained from the truth table the logical way forward would have been to build an optimization model to minimize process repetition within process flow constraints.

The optimization model would have had to incorporate logical process flow convergences and divergences as well as sequence constraints. The effort of an individual project would have been required to build such an optimization model and would have held no guarantee of providing a “better” solution to the problem than what has been discovered. There are 36 individual processes in the admissions SOP and a total of 41 processes in the above solution; therefore even if an optimization model eliminated process repetition it would only yield a 4,8% improvement on the above solution (in terms of a reduction in the total number of processes in the solution).

Analysis of the Deming Method:

Seeking appreciation for the system uncovered an empirically and theoretically justifiable solution to the problem without the need for an optimization model. Here the application of the Deming Method has saved time and effort in deriving a solution to a problem.

5.1.9 Conclusion C

In this case Deming’s concept of “theory of knowledge” has been proven sound: empirical evidence accurately predicted the existence of at least a single credible theoretical difference between occupants and visitors.

The truth table of section “5.1.5 Preliminary resolution” indicates that the process flows of “occupants” are considerably similar to each other and considerably unlike the process flows of “visitors”. A theoretical reason for the difference is expressed in section “5.1.5 Preliminary resolution”; (animals that are visitors are expected to be released back to their homes whereas it is uncertain how occupants will leave the SPCA care system).

Analysis of the Deming Method:

The discovery of a logical difference between occupants and visitors did not affect the development of the solution. Even if “theory of knowledge” had not been present the empirical data could still have been used to achieve the same solution. In this case theory of knowledge has offered a better understanding of the system but is otherwise inconsequent.

5.2 Module 2: The SOP and PSOP

In application module 1: The Admission Procedure, an attempt was successfully made to simplify the admissions procedure without changing the information which it conveys. The chosen solution was to restructure the process flows within the SPCA's internal document of standard operating procedures (SOP). The author of this project discussed the solution in sections "5.1.6 Resolution" and "5.1.7 Solution" with the author of the SOP and a number of desirable changes to the original SOP could be identified.

The objective of this module is to refine the solution of section "5.1.7 Solution" into a complete and immediately employable replacement for the admissions section of the SOP. This new document will from this point in the texts onwards be referred to as the proposed standard operating procedures document (PSOP). In accordance with the sentiments of section "5.1.3 Analysis", the original SOP should not be discarded but rather retired from general usage and employed solely for training purposes.

5.2.1 Preliminary resolution

The author of the SOP has identified the following issues with the original SOP by analyzing sections "5.1.6 Resolution" and "5.1.7 Solution"

1. The Get_Owner_Signatures process and an attempt to verify ownership should take place for all occupants delivered to the SPCA by members of the public.
2. The PoundInspector_informs_VetServices_of_further_action process must occur periodically for every stage 1 animal throughout stage 1, not only for impounded and confiscated animals but also for strays. (Unwanted animals do not enter stage 1).
3. The VetReport_OfficerActions process has been identified as a process that should be executed if any injured animal arrives at the SPCA after hours.
4. The author of this project misunderstood the purpose of the Proof_of_Income process. Proof of income serves the dual purpose of restricting SPCA clinic resources to clients who can not afford to pay a private veterinarian and for adjusting the cost of the treatment to appropriately correspond to the client's disposable income. Therefore the decision whether or not to treat an animal based on the Proof_of_Income process must be changed.
5. In the case of an emergency, if an animal brought to the SPCA requires immediate treatment then the veterinarians at the SPCA will treat it regardless of proof of income.
6. Duties of the Special Operations Unit have been transferred to the Inspectorate.
7. All cases in which an animal shows signs of abuse must be referred to the Inspectorate.
8. If a boarding animal is not fetched by its owners then it enters the system at stage 0 as an abandoned animal.
9. All livestock and wildlife cases of occupants must be referred to the Inspectorate, not only strays.
10. The vaccination process for occupants takes place before the animal enters the adoption process, i.e. just before stage 3.
11. Boarding is at the SPCA's discretion and operational requirements such as the availability of kennels does play a role in the decision whether or not to board an animal.
12. All occupants have the same animal registration details, boarding animals require different animal information before the animal can be admitted.

5.2.2 Resolution

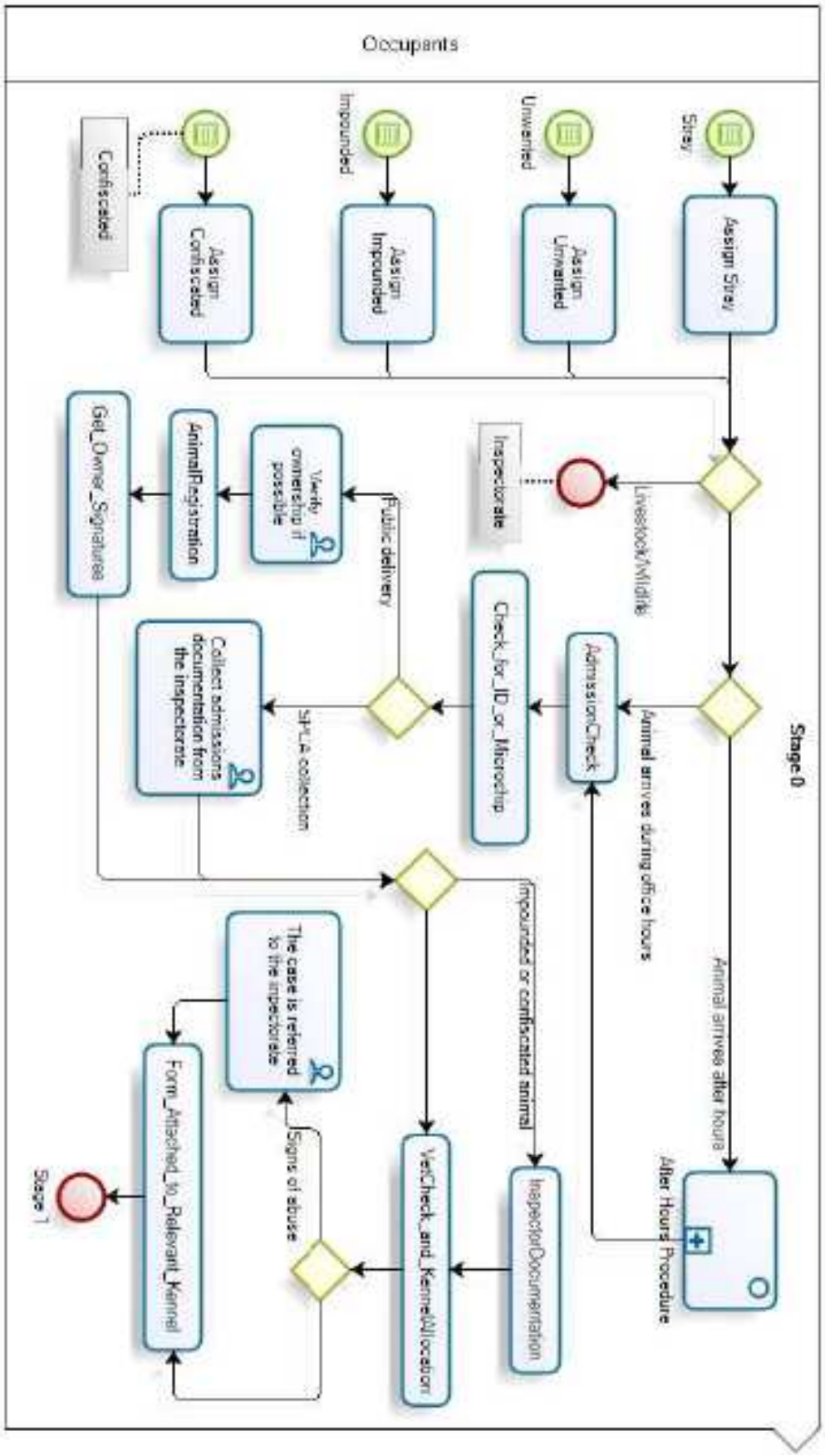


Figure 15: PSOP for occupants

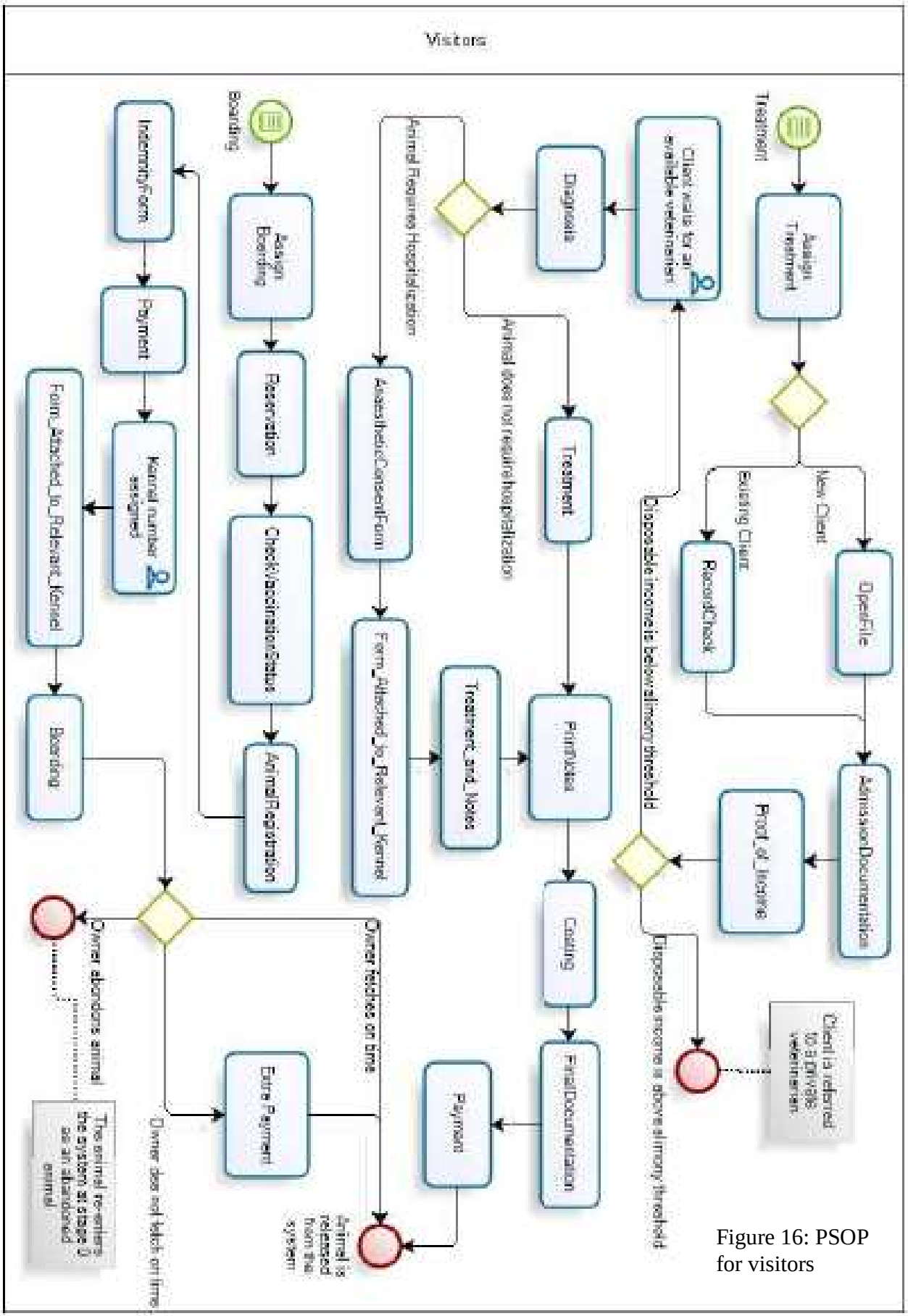


Figure 16: PSOP for visitors

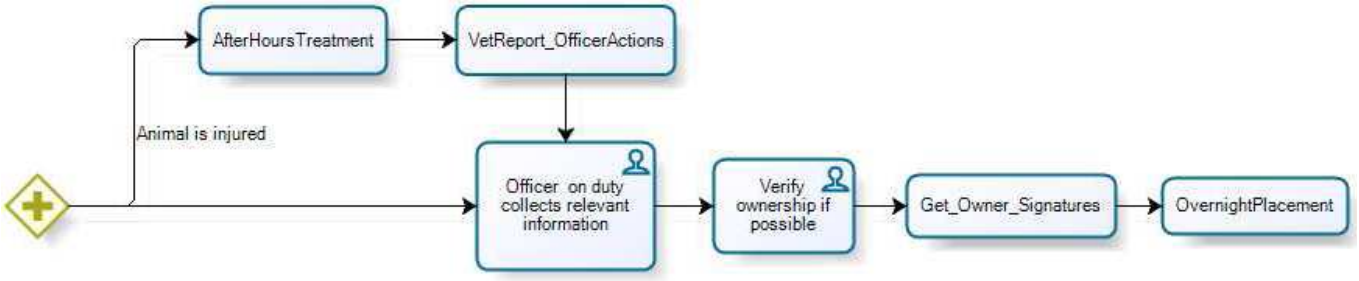


Figure 17: PSOP for after-hours arrivals

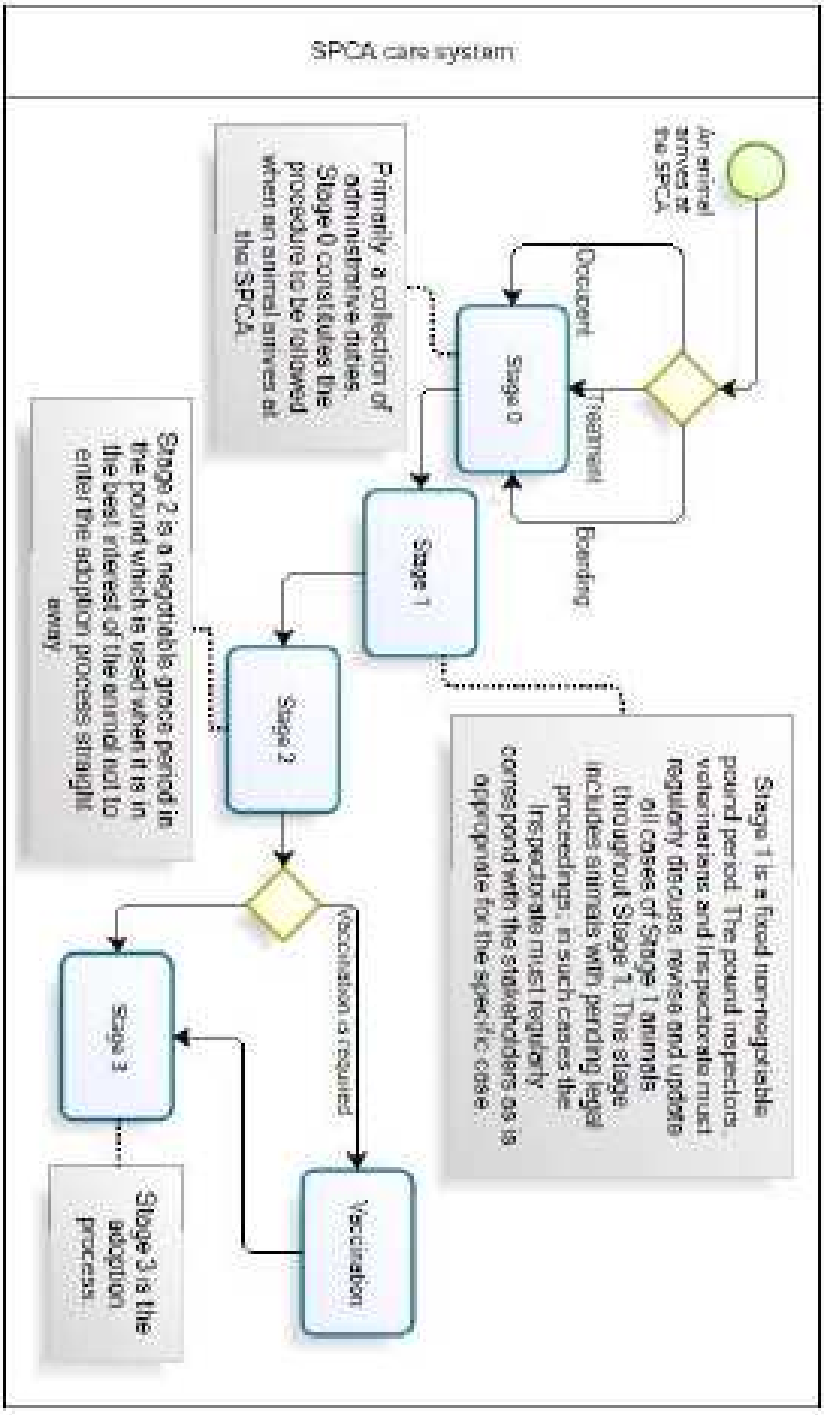


Figure 18: PSOP system overview

5.2.3 Solution

What follows is a complete and accurate document describing the admissions procedures at the SPCA. This document, the PSOP, is intended to serve as an everyday reference document containing the complete set of *administrative* steps that must take place when an animal arrives at the SPCA.

Admissions system overview:

1. Any animal that the SPCA has contact with that is not already in stage 1, 2 or 3 is automatically and constantly considered to be in stage 0 until it enters stage 1, 2 or 3. Stage 0, which is clearly outlined as a part of the PSOP, can be considered to be the stage in which all of the administrative and veterinary duties pertaining to a new arrival at the SPCA are carried out.
2. The stages are sequential while the system is cyclic in that the only way in which an animal may enter a prior stage is by being re-admitted into the system as a stage 0 animal.
3. It is possible for an animal to skip stages depending on the individual case.
4. Stage 1 is a fixed non-negotiable pound period. The pound inspectors, veterinarians and Inspectorate must regularly discuss, revise and update all cases of Stage 1 animals throughout Stage 1. This stage includes animals with pending legal proceedings; in such cases the Inspectorate must regularly correspond with the stakeholders as is appropriate for the specific case.

   Although subject to change, the following table contains the stage 1 period for each category of animal that can possibly enter stage 1. (Animal_Placed_in_PoundKennel, PoundInspector_informs_VetServices_of_further_action, LawApplication):

Animal Category	**Stage 1 period**
Stray animals	7 days
Impounded animals	Defined through by-laws
Confiscated animals	Defined through by-laws
Unwanted/abandoned animals	0 days

Table 10: PSOP table of stage 1 periods according to category

5. Stage 2 is a negotiable grace pound period which is used when it is in the best interest of the animal not to enter the adoption process straight away.
6. Stage 3 is the adoption process. (Animal_Placed_in_AdoptionKennel)
7. Throughout stages 1, 2 and 3 after each revision of an animal's case a note must be made of the next recommended revision of that animal's case. The period of time before the next revision of a case must be chosen subjectively based both on the best interests of the animal and on operational constraints. Although an animal's case can be revised before the next recommended revision date; the recommended revision date will serve as a means of maintaining a clinical structure within the animal care process.
8. There are two broad categories of animal that can enter the SPCA care system:
   - Occupants are animals with an uncertain future. Strays, impounded, abandoned, unwanted and confiscated animals are all to be considered occupants.
   - Visitors are animals that are brought to the SPCA by their owners or care givers and are expected to return to their original homes when they leave the SPCA care system. Animals brought to the SPCA solely for boarding or treatments are to be considered visitors.
9. The animal's relevant "forms" must always be attached to the animal's kennel. (Form_Attached_to_Relevant_Kennel)

Stage 0: occupants:

1. An animal arrives at the SPCA.
2. If any animal in any stage is injured at any time then it must receive veterinary care as soon as possible. (AfterHoursTreatment, Treatment).
3. If the animal falls under the category of "Livestock/Wildlife" then it is immediately referred to the Inspectorate.

Stage 0: occupants: after-hours procedure:

4. If the animal is injured then it must receive veterinary care as soon as possible. (AfterHoursTreatment)
5. If any injured animal arrives at the SPCA after hours then the veterinarian who is on duty must submit a report construing the action of the on-duty admissions officer. This process is intended to aid the correction of unsatisfactory performance of duties and to give credit to after-hours admissions officers where credit is due. (VetReport_OfficerActions)
6. The on duty officer must collect relevant information from whoever brings the animal to the SPCA, especially if the animal is delivered by a member of the public because that might be the last contact that the SPCA has with that person/party. (AnimalRegistration)
7. The on duty officer must attempt to verify ownership of every animal that is delivered to the SPCA after-hours and
8. get the owner's signatures on necessary documents. (Get_Owner_Signatures)
9. The animal is then placed in a holding kennel until the next morning (OvernightPlacement).
10. As soon as possible the next morning the office-hours procedures are carried out.

Stage 0: occupants: office-hours procedure:

11. The animal is checked at the admission point and it is determined what category the animal belongs to. (AdmissionCheck)
12. The animal is checked for an ID tag or a microchip. (Check_for_ID_or_Microchip)
13. If the animal is delivered to the SPCA by a member of the public then the staff member handling the admission of the animal must attempt to verify ownership of the animal and
14. get the owner's signatures. (Get_Owner_Signatures)
15. The animal's details are collected and entered into the information system. (AnimalRegistration)
    The following is a list of information that the staff member handling the admission must attempt to obtain:
    - Name, residential address and contact number of finder
    - Time and date that animal was found
    - Place where animal was found

    Description of the animal:
    - Age
    - Breed
    - Colour
    - Sex
    - Distinctive markings or injuries
    - Size of the animal

    Case update:
    - Time and date of admission onto system/ form.

16. If the animal was collected by the Inspectorate then the inspector's admissions documentation must be compiled, collected and entered into the SPCA's information system.

17. If the animal is impounded or confiscated then the relevant documentation must be collected from the Inspectorate and entered into the SPCA's information system. (InspectorDocumentation)
18. A veterinarian checks the animal's health and allocates a kennel for it. (VetCheck_and_KennelAllocation)
19. If there is evidence or suspicion that the animal was abused then the case must be referred to the Inspectorate.
20. The animal's "form" is attached to the kennel that was allocated to it. (Form_Attached_to_Relevant_Kennel)
21. The animal enters stage 1, 2 or 3 depending on the individual case.

Boarding animals: before the animal arrives at the SPCA:

1. A reservation is made for a boarding kennel. Advance reservation for boarding is essential. (Reservation)
2. The following animals cannot be accepted:
    - Animals younger than six months.
    - Animals under medication or chronic treatment.
    - Pregnant, whelping or lactating animals.
    - Injured or sick animals.
3. The boarding period may not exceed thirty continuous days.
4. Animals in boarding can only be collected during office hours.
5. Boarding fees are calculated per night. If the animal is collected after 12h00 then it counts as a full day's boarding.

Boarding animals: after the animal arrives at the SPCA:

6. The vaccination status of the animal is checked. (CheckVaccinationStatus)
7. The animal's details are collected and entered into the information system. (AnimalRegistration)
   The following is a list of information that the staff member handling the admission must obtain for the animal to be admitted.
    - Name, residential address and contact number of the owner or another responsible person.
    - Name and contact number of the animal's veterinarian.
    - Address and contact number of owner during time of absence.

   Description of the animal:
    - Age
    - Breed
    - Colour
    - Sex
    - Distinctive markings or injuries
    - Size of the animal

8. The owner of the animal must complete and sign an indemnity form. (IndemnityForm)
9. Payment for the entire reserved boarding period is collected before boarding starts. (Payment)
10. The animal is assigned a kennel number. (KennelAllocation)
11. The animal's "form" is attached to the kennel that was assigned to it. (Form_Attached_to_Relevant_Kennel)
12. The animal boards at the SPCA. (Boarding)

13. The animal can leave the boarding process in one of four ways:
    a. The owner collects the animal as originally agreed. (WaitForOwners)
    b. The owner collects the animal earlier than agreed. (WaitForOwners)
    c. The owner collects the animal later than agreed, in which case extra payment is required. (ExtraWaitForOwners, ExtraPayment)
    d. The owner does not collect the animal within a predefined number of days after the end of the reserved boarding period; in which case it is admitted as an abandoned animal at stage 0. Five days is the current extra waiting time. (ExtraWaitForNothing)

Treatment animals:

1. If the client is new then a file must be opened for that client. (OpenFile)
2. If an existing client brings an animal to the SPCA for treatment then that client's record must be checked. (RecordCheck)
3. Admission documentation must be completed. (AdmissionDocumentation)
4. Proof of income must be collected from the client. (Proof_of_Income)
5. If the client's disposable income is above the threshold for alimony then the client is referred to a private veterinarian.
6. The client waits in the clinic reception for a consultation with an available veterinarian.
7. A veterinarian diagnoses the animal. (Diagnosis)
8. If the animal does not require hospitalization then it is treated. (Treatment)

Treatment animals: animal requires hospitalization:

9. An anaesthetic consent form must be completed. (AnaestheticConsentForm)
10. The animal's "form" is attached to the relevant kennel. (Form_Attached_to_Relevant_Kennel)
11. The animal is treated and notes are made regarding the treatment. (Treatment_and_Notes)

Treatment animals: final duties

12. Notes concerning the treatment of the animal are printed out. (PrintNotes)
13. The cost of the treatment and/or hospitalization is determined. (Costing)
14. Final documentation is completed. (FinalDocumentation)
15. Payment is collected from the owner of the animal before it is discharged. (Payment)

5.2.4 Conclusion

The solution of “5.1 Module 1: The Admissions Procedure” did make the SOP easier to understand.

The changes to the SOP that are proposed in section “5.2.1 Preliminary resolution” developed as a result of discussing the findings of module 1 with the author of the SOP. Some of the suggestions are corrections of mistakes in the SOP, some are resolutions of ambiguity in the original document and some changes are logically motivated by new insight into the original SOP gained through appreciation for the system.

Analysis of the Deming Method:

The suggestions of changes to the content of the SOP arose when its author discussed the solution of module 1 with the author of this project. Section “5.2.1 Preliminary resolution” can be interpreted as evidence that the use of the Deming Method in module 1 was successful because the author of the SOP gained insight from the solution to module 1. To a certain degree the solution to module 1 did simplify the SOP without changing its content.

5.2.5 Author’s Note

There are a number of features that have been included in the PSOP that were not included in the SOP such as the division of the SPCA care system into four stages, the closed loop control of an after-hours officer’s performance in the case of an injured animal arriving at the SPCA after-hours, a formal grace period in the pound and the concept of maintaining a case revision schedule for all SPCA animals.

These features are included in the PSOP in accordance with an application of the Deming method. There is however no empirical data available from which conclusions can be drawn. It is stated in section “5.1.5 Preliminary resolution” that “the first step towards being able to improve the operations model is to develop a “flawed” model of operating procedures that is easier to work with than the “flawed” model represented in section “5.1.1 Appreciation for the System””. The flawed model that was easier to work with was the solution to model 1, module 2 has primarily been completed for the sake of completeness of the solution.

5.3 Module 3: Microchip Inspection

One of the ways that the SPCA attempts to identify animals or verify ownership is by checking the animal for an existing microchip. The microchips are passive radio frequency identification (RFID) integrated circuits, each about the size of a grain of rice, each with a unique identifying number. The microchips are implanted with a syringe and hypodermic needle in the inoculation site which for dogs and cats is between the shoulder blades. The RFID scanner is approximately the size and shape of a ping pong paddle and if it is held close enough to the microchip then it reads the unique microchip number and displays it on a small LCD screen.

Worldwide there are a number of animal microchip vendors and in South Africa Identipet is the leader in the field claiming that they have 97% of the market share on their website which can be viewed at <http://www.identipet.com/qafrm.htm>. On the same webpage Identipet also claim that their implants do not migrate. The migration of microchip implants away from the original implant site by means of natural bodily processes is a concern because if the microchip is not where it was implanted then the probability of finding it with the microchip reader decreases. Regardless of Identipet's claims, 3% of South African animals with microchips still have microchips which can not boast Identipet's patented BioBond^{tm} technology.

If a lost animal with a microchip enters the SPCA system and the microchip is found then that animal can go home. This is a crucially important inspection process that is literally a matter of life and death for many animals with microchips. As Deming has made his views on inspection procedures clear and because checking a lost animal for a microchip is such an important process; this process is analysed.

5.3.1 Appreciation for the System

- The Check_for_ID_or_Microchip process described in modules 1 and 2 currently takes place as soon as possible after the animal has arrived at the SPCA.
- There is a place on the kennel form for the microchip number to be written if a microchip is found. If a microchip is not found then that space is left blank.
- There is no formal procedure for using the scanner to check for a microchip but the personnel who do the checks seem to be thorough and it appears that the concept of implant migration is common knowledge at the SPCA.
- Although it is not formally expressed; all stray animals are normally checked by two or three personnel to make sure that a microchip was not missed.
- Finding an existing microchip takes approximately five seconds.
- Searching for a non-existent microchip takes approximately fifteen seconds.
- The person who fetched the microchip reader to demonstrate the inspection process took approximately two minutes to fetch it. The demonstration was at the admission point for animals collected by the Inspectorate.
- The author of this project asked the gentlemen who conducted the demonstration whether an animal with a microchip ever slips through the microchip inspection process; he replied that missing an existing microchip never happens.

5.3.2 Analysis A

Just by inspecting an animal's documentation there is no way of telling whether an animal has not been checked for a microchip or whether it does not have a microchip. There is an informal method in place which is employed to make sure that all of the animals have been checked for microchips before they leave stage 0, but because it is not documented there is an unnecessary possibility of an animal not being checked due to human error.

5.3.3 Solution A

The solution is simple; if an animal is checked for a microchip, even if no microchip is discovered, then a note should be made in the animal's documentation saying that the animal has been checked for a microchip. The benefit of this would be that even though a possibility will always remain that an existing microchip is not found, at least the possibility of an animal not being checked for a microchip due to human error is greatly reduced.

This method will however require that a new inspection task is created: at some appropriate stage the animal's forms must be checked to make sure that the animal has been checked for a microchip. An example of a rule that would necessitate this inspection task is that "an occupant must have been checked for a microchip before it can leave stage 0", therefore before the animal can enter the pound or adoption process there must be a note on the animal's kennel forms indicating that the animal has been checked for a microchip.

5.3.4 Conclusion A

An easy, costless method of ensuring that all animals are checked for microchips has been discovered.

Analysis of the Deming Method:

The gentleman who demonstrated the Check_for_ID_or_Microchip process was convinced that all stay animals are checked for microchips. The truth is that without documentation it is impossible to know for certain whether an animal has been checked for a microchip or not. He did not see this problem but a quest to appreciate the system has uncovered its existence.

One of Deming's 14 points for management is to attempt to improve the quality and productivity of a system constantly forever. In this case the quality of the system could be improved at no cost simply by attempting to improve the system while conscious of the principals of profound knowledge.

5.3.5 Analysis B

If more than a single person is responsible for checking an animal for a microchip then none of them will be motivated to do it properly because even if one of them misses the microchip it does not matter: either someone else will also check for it or someone else has already checked. In this specific case the danger of this dynamic is amplified by the nature of the problem: if (for whatever reason) the implant is in an unusual place then there is much less chance of finding it with three half-hearted inspections than with a single thorough inspection because everyone will obviously check for the microchip where it is supposed to be before exploring the idea that the microchip is somewhere else.

5.3.6 Solution B

Have a single person inspect an animal for a microchip and let him/her make a note on the kennel form of who carried out the inspection. This solution fits in well with "5.3.2 Solution A" and it will eliminate the dangers of divided responsibility. If an animal does not have a microchip then the space on the kennel form for entering the unique microchip number will be blank. If a single person must initial that space after checking for a non-existent microchip then the problems of analysis A and B will virtually be solved.

5.3.7 Conclusion B

In this case the use of scientific common sense (Taylorism) to improve the system by having more than a single inspector produces adverse effects. A modest understanding of psychology explains how in this case 200% or 300% inspection costs more man-hours and provides poorer quality inspection than the use of 100% inspection.

Analysis of the Deming Method:

"200 per cent inspection, as usually carried out, is less reliable than 100 per cent inspection for the simple reason that each inspector depends on the other to do the job. Divided responsibility means that nobody is responsible" (Deming, 1982, p. 30).

This case is a fine example of adverse effects resulting from an attempt to improve a system without a system of profound knowledge being in place: psychological considerations were neglected.

"5.3.5 Solution B" also allows the microchip inspector to take pride in his work because if there is only a single inspector then the life of the animal is predominantly in his/her hands. By instituting solution B the inspector can achieve a sense that doing the job properly actually makes a difference.

5.3.8 Analysis C

The set-up time required before inspection for a microchip can begin consists of the time that it takes to locate an available microchip scanner and take it to the animal that must be scanned. As mentioned in section “5.3.1 Appreciation for the System”; the set-up time is easily longer than the time taken to scan an animal for a microchip. Occupants are all scanned individually as soon as possible after the AdmissionCheck process, which means that while the aim of the process is to scan animals for microchips; more man-hours are being spent searching for and fetching the scanner than on scanning animals.

5.3.9 Solution C

General systems theory suggests that the solution to this problem is batch processing in an attempt to reduce set-up frequency. The SPCA has a designated buffer zone for new arrivals which consists of 20 cat kennels and 20 dog kennels which also serve as the holding kennels for after-hours arrivals.

The logical first batch consists of the after-hours arrivals. In the morning the holding kennels usually contain a number of stage 0 occupants that need to be checked for microchips. If the scanner is there anyway to scan the first animal of the day then the set-up time-cost of scanning each animal individually as a part of its individual process flow can be avoided by scanning all the animals in the holding kennels at once.

The holding kennels could be used throughout the day as a buffer zone for batch processing microchip inspections. If a rule was made that unless an animal has been checked for a microchip it may not leave the holding kennels then the following configurations can be viable:

- All of the animals in the holding kennels could be checked for microchips on a fixed time period basis. For example: at the top of every hour someone could check all of the unchecked animals in the holding kennels for microchips.
- All of the animals in the holding kennels could be checked for microchips whenever the holding kennels are almost full.
- There could be a flexible time schedule of scanning for microchips in the holding kennels. For example there could be a three-hourly rotation of a scanner between the clinic and the holding kennels. This way the person responsible for checking for microchips would be able to choose when to scan all of the animals in the holding kennels within a three hour period that starts every six hours.

Other possibilities include using the pound kennels or any kennels at the SPCA as buffer kennels for animals that have not yet been checked for microchips. If the buffers are chosen to be arbitrarily large then the batch sizes could be arbitrarily large. For example: at the end of the day someone could check every animal in the SPCA care system for either a microchip or evidence that the animal has already been checked.

How the batch processing is configured depends on an evaluation of the time value associated with when the inspection for a microchip takes place: the sooner a microchip is found, the sooner the animal’s owner can be contacted. Checking for microchips on an individual basis to attempt to verify ownership might be viewed as mandatory depending on the value of attempting to verify ownership while a certain inspector or a supposed owner is physically at the SPCA.

5.3.10 Conclusion C

Systems theory easily suggested an improvement to the scenario expressed in section “5.3.8 Analysis C”. The extent of the usefulness of the suggested solution depends heavily on how a trade-off between the value of man-hours and the value of immediacy is to be judged.

Analysis of the Deming Method:

Batching to reduce set-up frequency is a commonly used Industrial Engineering tool. In this case a general appreciation for systems provided a questionably feasible suggestion for system improvement.

5.4 Module 4: Kennel Resource Management

Due to the difficult circumstances that are the operational status quo for the NSPCA and the SPCA; system resources are severely limited. The SPCA is starved of funding, veterinary staff, equipment and kennels. The SPCA's kennels are perhaps its most tangible resource. This module attempts to optimize kennel utilization.

5.4.1 Appreciation for the System

In an attempt to gain a better understanding of the system, the results of the Rockwell Arena 10.0 simulations of section "5.1.1 Appreciation for the System" were analysed. To avoid the use of euthanasia statistics for the reasons expressed in section "1.3 Introduction to the SPCA," the adoption process was configured to release animal entities directly out of the SPCA system. Using the SPCA's arrival statistics as process flow inputs; the models of strays, unwanted, impounded and confiscated animals all exploded at the Animal_Placed_in_PoundKennel process.

5.4.2 Analysis

The simulations revealed that without the inclusion in the model of euthanasias and lost animals being claimed from the pound; occupants enter stage 1 faster than they leave it. The process models of section "5.1.1 Appreciation for the System" are not under statistical control. The simulation models have shown that the SPCA care system only functions practically because euthanasia is used to supplement the adoption and pound processes to force the number of animals leaving the system to approximate the number of animals entering the system.

5.4.3 Conclusion

Kennel usage at the SPCA cannot be optimised without prescribing a euthanasia process to offset the difference between arrival rates and adoption and animal reclaim rates. Besides the fact that this paper deliberately avoids the issue of euthanasia; formally defining systematic euthanasia would be a foolish thing to do in a system where every system entity has unique case and personality.

The system is as optimal as it can be considering the current state of affairs: the kennels are always utilized as much as possible, animals with the best chance of being adopted are kept in the adoption process longer than other animals, and animals with the best chance of being reclaimed are kept in the pound process longer than other animals.

This is paper focuses on Industrial Engineering and amongst other goals attempts to express the value of considering human psychology when applying the tools and techniques of Industrial Engineering. Ironically and unexpectedly this specific case requires an understanding of animal psychology in the application of Industrial Engineering techniques. The mental and physical health of dogs in kennels deteriorates over time, breeds and individuals however react differently to the SPCA care system. "Understanding the rescue dog" and "Saved!" are books entirely devoted to understanding the behaviour, mental and physical health of dogs in animal welfare kennels. Papurt (1997, p. 47) devotes a chapter to "Behaviour of Dogs in Cages".

Bearing in mind that an animal's mental and physical health in animal welfare kennels is constantly changing there is no space for optimizing kennel resource management other than attempting to use an understanding of animal psychology to make sure that as many animals as possible receive the best possible probability of being adopted or reclaimed.

This module, which used Rockwell Arena 10.0 simulation software in an attempt to optimise kennel resource management, has yielded a better understanding of the system but no ideas for system improvement.

Analysis of the Deming Method:

Knowledge about variation saved the trouble of searching for a non-existent solution. "A process may be in statistical control; it may not be. In the state of statistical control, the variation to expect in the future is predictable. Costs, performance, quality, and quantity are predictable. Shewhart called this the stable state. If the process is not stable, then it is unstable. Its performance is not predictable," (Deming, 1994, pp. 99-100).

As a consequence of the inherent nature of the system the SPCA's kennel resource management is not under statistical control, the effects of modifications to kennel resource management procedures are therefore not predictable. Because the animal arrival, reclaim and adoption rates are predominantly outside of the SPCA's control the process flow of occupants can not be stabilized, euthanasia will unavoidably be required to prevent system explosion.

This module suggests a scenario in which the optimal kennel resource management procedures can only be derived directly from a system of profound knowledge and not from traditional Industrial Engineering techniques such as mathematical modeling or simulation:

- The system is not stable due to factors outside of the SPCA's control; theoretical prediction of a possible positive system modification to improve the utilization of the SPCA's kennels using mathematically motivated Industrial Engineering techniques is therefore not possible,
- appreciation for the system in the form of understanding animal behaviour and psychology is required in order to choose how animals should be differentiated based on their individual personalities,
- knowledge about variation is required in order to ensure that the system does not explode due to the animal arrival rate being greater than the system exit rate. At the same time a knowledge about variation is required to ensure the that the system exit rate is not greater than the system arrival rate so that kennel resource utilization can be maximized,
- theory of knowledge is required to accurately predict periodic variance of animal arrival rates so that the number of required euthanasias can be precisely calculated and
- an understanding of human psychology is required in order to predict which animals have a greater chance of being adopted by a member of the public.

6. Other considerations

Posters can be made of figures 15, 16, 17 and 18 and strategically placed in order to promote on-the-job training.

Conclusions

“Module 1: The Admission Procedure” concluded that a lack of appreciation for the system led to the development of a misguided problem statement which could be resolved by attempting to appreciate the system. It is also observed that a neglect of psychological considerations led to the creation of the problem in the first place.

Also noted in Module 1 is that the use of the Deming Method to solve the problem led to the discovery of a solution with considerably less effort than would have been required had the Deming Method not been used.

Theory of knowledge was sought and attained in Module 1 when the empirical evidence gained through an attempt to appreciate the system could be theoretically justified. In this case; theory of knowledge was of no value besides gaining a deeper understanding of the system. Although Deming repeatedly insists that theory of knowledge is necessary to provide a lasting improvement to a system; this case begs the question: if a solution works is it really necessary to understand why it works? It is however possible that the theory of knowledge attained in Module 1 may present latent benefits but such an assumption is pure speculation at this point.

No conclusions could be drawn from the solution of “Module 2: The SOP and PSOP” but section “5.2.1 Preliminary resolution” is evidence that the solution to Module 1 has already yielded benefits to the system by highlighting previously unforeseen problems with the SOP.

Module 1 and Module 2 can be interpreted as consecutive applications of the Shewhart Cycle to the same issue. Module 1 and Module 2 therefore showcase the effectiveness of the Shewhart Cycle in pursuing constant system improvement.

Three conclusions could be drawn from “Module 3: Microchip inspection”:

A. Appreciation for the system together with constancy of purpose toward improving the system can reveal costless solutions to problems that were not even evident before the appreciation for the system was gained.
B. Psychological considerations are vitally important when designing processes that involve people. In Module 3 it can clearly be seen that best efforts in the interest of the system can cause adverse effects if a system of profound knowledge is not present in devising solutions.
C. The benefits of appreciation for a specific system have already been showcased in this conclusion; Module 3 displays the benefit of a general appreciation for systems. In this case an understanding of general system theory provided a suggested solution to an inconvenience. It is worth stating that the feasibility of the solution derived in this case is unknown as it is dependant on subjective values and unknown information.

“Module 4: Kennel Resource Management” displays a benefit of understanding variation even though recommendations for improvement of the kennel management procedure were not discovered. Interestingly, Module 4 has presented itself as an obstacle that can not be overcome with simulation or mathematical modeling but can be overcome through the installation of a system of profound knowledge and the application of the Shewhart Cycle.

It can be concluded that although the use of the Deming Method in the application of Industrial Engineering tools and techniques may not always yield positive results; in the applications of this project the use of the Deming Method did not produce any adverse results. This project showcased a

number of scenarios in which best efforts to improve a system yielded adverse results because an underlying philosophy such as the Deming Method was not used in devising those solutions.

The results of this project suggest that the use of an Industrial Engineering philosophy in the application of Industrial Engineering tools and techniques always provides solutions which are either the same or better than solutions devised without the use of an Industrial Engineering philosophy.

7. Author's Notes

The literature review uncovered interesting insights into the subject of this project:

- there is an overwhelmingly negative attitude towards Taylorism despite its widespread usage,
- this project seems to be the first of its kind,
- although it is never well-articulated; the issue which this project will attempt to address has been noted by the academic community,
- definitions of Industrial Engineering are vague,
- Eskandari et al. (2007) has published a paper on the academic and industrial community's opinion of the desirable traits of industrial engineers,
- Taylorism and the Deming Method are mutually exclusive ideologies,
- there is renewed contemporary interest in the Deming Method and
- there seems to be substantial existing evidence that using the Deming Method will provide better results than not using the Deming Method in the application of Industrial Engineering techniques.

The aim of the project was successfully achieved.

A worthwhile note is that industrial engineers often seek out a problem that can be solved using a predetermined Industrial Engineering technique. This project, if nothing else, has displayed the fact that the Deming Method is perfectly generic in its ability to aid the quest for improvement of any system or process.

The author of this project would like to include an expression of his sincere gratitude for the patience, hospitality and accommodation that the staff at the SPCA so willingly offered. Without the unfailing support of the SPCA this project would still have been possible but it would have been more difficult and considerably less pleasant.

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Throughout the project the following individuals at the SPCA were consulted:

Mr. C Allan, Managing Director
Mr. H.A. Bennett, Administration Manager
Mr. M. Nieuwenhuizen, Handyman
Mr. W. Mashimaite, Kennel Controller

Appendix A: OR – A Brief Literature Review

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16/09/2009

OR (operations research) has become an abstract concept: difficult to define within clear boundaries between the field of operations research and its related domains. Fuller and Mansour (2003, p.422) illustrate the overlapping between OR and OM (operations management). Even Russel L. Ackoff, one of the outstanding authors of OR literature (Corbett & Wassenhove, 1992, p.625; Fuller & Mansour, 2003, p.422), calls OR a pure science (Ackoff, 1956, p.265), but his paper describes not a science but a technology. Amidst all the confusion as to what OR actually is, Corbett and Wassenhove (1992, p.625) have an eloquent argument on this matter which will be adopted for the purposes of this paper; they describe OR as a bipolar combination of a "knowledge-oriented science" and a "problem-oriented technology".

Although the objective of this paper is by no means to simply define OR, understanding what OR is, is imperative to understanding the application, theory, academic value and critiques of the field of OR in context. As such, what follows is a brief history of the origins of OR and its development into what is today known as OR. After the diachronic analysis of OR is a definition of OR in a contemporary context. This paper will then analyze the two primary components that OR has developed into and resulted in; the academics and the technology that is OR. Before the conclusion of the essay is a perspective on the role of OR in IE (Industrial Engineering).

The early development of OR

The success of any endeavor is directly proportional to the quality of its managerial decisions; although obvious, this is a profound concept with implications that are still being discovered in areas as diverse as war strategy through to contemporary business logistics philosophy (Coyle et al., 2003). Applied sciences in the form of the various classical engineering disciplines allowed academic scientific developments to be used in practice. There was however no substantial science for the application of the "scientific method" in the field of management. Corbett and Wassenhove (1992, p.625) and Ackoff (1956, p.265) trace the origin of OR back to WWII whereas Fuller and Mansour (2003, p.422) claim that, "OR had its roots in the early scientific management effort emphasized at the turn of the centaury and during World War I". What can be agreed upon is that from WWII, and 1937 in particular (Fuller & Mansour, 2003, p.422), OR existed and was being used to aid the war effort. In what some believe to be the "genesis" of OR, in 1937 civilian scientists in England were, "assisting military executives in learning how to properly utilize the newly-developed radar technology and equipment for anti-aircraft weapons fire control", (Fuller & Mansour, 2003, p.422). The tools, techniques and methods used to accomplish the optimization of the utilization of the radar technology were termed "operations research" and spread through Great Britain's government and industry.

Although seventy years after OR started its first growth spurt it may seem strange that OR was so readily absorbed into management culture, but it is important to bear in mind that (unlike today) there was a void of tools to aid management in making decisions. Throughout time there have been large

scale operations that would benefit from the application of OR, the construction of the pyramids for example, but the technology of OR only became feasible with the advent of data processing equipment in the form of the early digital computer in the late 1930s and early 1940s (Encyclopedia Britannica Ultimate Reference Suite, 2009, "Computer"). Management of large scale war operations where resources were limited (WWII) was the perfect technology driver and OR thrived in the intense research climate. Here for the first time the "scientific method" was being applied in management.

The term, "operations research" was coined by McCloskey and Trefethan in 1940 in the USA (Gaither, 1973), but unlike the seamless absorption of OR into management in Great Britain (Fuller & Mansour, 2003, p.422), OR was not granted due consideration by the US industry until 1950. What sparked renewed interest in OR was the potential for the application of OR in the automation of factory processes (Ackoff & Rivett, 1963), where the high volume repetitive manufacturing could greatly benefit from optimization. "The term automation was coined in the automobile industry in about 1946 to describe the increased use of automatic devices and controls in mechanized production lines", (Encyclopedia Britannica Ultimate Reference Suite, 2009, "Automation") and together with the introduction of IBM mainframe computers in the 1950s and 1960s (Encyclopedia Britannica Ultimate Reference Suite, 2009, "Computer"), OR in the US started to catch up with the developments of OR in Great Britain.

In 1959 IBM introduced its IBM 1401 mainframe computer which was rented for about $8,000 per month (Encyclopedia Britannica Ultimate Reference Suite, 2009, "Computer"), and from this point on computers quickly became more accessible to the larger economic entities in the manufacturing industry. In the 1960s something strange started to happen; although computer technology was becoming increasingly accessible and facilitating OR in the intense new automated mass manufacture climate, the British OR community that blossomed during the war two decades before was losing its optimism (Dando & Bennett, 1981). Sentiment "evolved from very optimistic in 1963, through optimistic in 1968 and unsure in 1973, to gloomy in 1978", (Corbett & Wassenhove, 1992, p.625).

When it was born, OR was basically the application of the scientific method within the management arena; as such, OR, MS (management science) and ME (management engineering) referred to the exact same concept but were used independently in various context around the globe as the field developed. Pioneers in the field of OR included Frederick Taylor, Henry Gantt, and Frank and Lillian Gilbreth (Chase et al., 2001). These revolutionaries and their contemporaries started to build a base of theoretical knowledge that would become the backbone of OR. Writers like Ackoff (1962) proposed that despite the obvious potential of OR, "if it was to be accepted as a field in its own right and not prove to be just a short-lived fad;" then it would have to "develop its own body of theoretical knowledge", (Corbett & Wassenhove, 1992, p.625).

At this point in time OR was a complete and self-contained field of science. OR/ME/MS was simply the application of the scientific method in aiding managerial decisions. OR was a philosophy, a discipline and contained its own tools and techniques.

The late development of OR

The OR method is the scientific method adapted to correspond with OM (operations management) and has become somewhat standardized (Ackoff, 1956, p.265). Ackoff (1956) includes six steps in his OR method:

- Formulating the problem,
- Constructing a mathematical model to represent the system under study,

- Deriving a solution from the model,
- Testing the model and the solution derived from it,
- Establishing controls over the solution,
- Putting the solution to work,

whereas the author has been taught an OR method which is a closed loop with 4 steps (Cronje, C 2009, University of Pretoria) :

- Formulate problem,
- Model the problem,
- Find a solution,
- Make a decision.

After the early developments in the knowledge base that OR is founded upon, Corbett and Wassenhove (1992, p.625) propose that a polarization of OR started to take place. Thrilled with the idea that science could finally be applied to management; the field of OR caused the birth of MS (management science) and MC (management consulting). MC can be viewed as the fruits of OR, the technology that includes all the methods that early OR proved valuable in making the “best” possible managerial decisions. MS consisted of the continuing academic improvements to OR including philosophical debates, mathematical improvements to the techniques and the general research that sustains interest any field of science.

Corbett and Wassenhove (1992, p.625) argue that the pessimism in the field of OR can be attributed to the underdevelopment of the link between MS and MC. The result of the “underpopulated area of activity”, “between 'pure theory' (management science) and 'pure practice' (management consulting)”, (Corbett & Wassenhove, 1992, p.625), is that the algorithms of MC continued to improve into the techniques and tools that are taught in OR courses today (Yousef, 2009, p.421), and the theory of management as a science developed independently in institutions of learning without the financial support of MC (even though MS is the source of innovation in MC).

"As an applied science, the work is torn between two objectives: as applied it strives for practical and useful work; as science it seeks increasing understanding of the basic operation, even when the usefulness of this information is not immediately clear", (Flood, MS, 1955).

MS (The academic value of OR)

Academics have become disenchanted with OR, which is understandable: “it was in 1973 and more viciously in 1979, that Ackoff pronounced OR/MS dead”, (Corbett & Wassenhove, 1992, p.625). Abbott (1988) observes that the greater OR community (including industrial engineers) is trying to convince the greater scientific community of the validity of OR as a science in itself, but in truth MC (which is the technology derived from OR) can be applied with little or no underlying education in OR. The result is that courses in OR contain much theory that is valid and accurate, but of little or no practical use (Corbett & Wassenhove, 1992, p.625), and as such OR has struggled to establish itself in the shadow of the classical engineering disciplines. “In the face of all aridity and disenchantment”, (Unknown, “Desiderata”), it is heartening that some progress is being made in the academically orientated facet of OR.

Bixby (1992, p.315) showcases the progress made in linear programming over the last 40 years (before 1992). An example of the progress made in this area is Bixby’s (1992, p.315) claim that “three orders of magnitude in machine speed and three orders of magnitude in algorithmic speed add up to six orders

of magnitude in solving power: A model that might have taken a year to solve 10 years ago can now solve in less than 30 seconds."

For the most part however, OR is suffering from the distancing of the practice of OR (MC) from the theory of OR (MS) (Corbett & Wassenhove, 1992, p.625) and the resultant situation is that any progress that is being made is slow, under-funded and isolated. For example there is huge potential for heuristic OR methods (Simon & Newell, 1958, p.1) but MC has not yet seen the benefits of this trail due to lack of research, and more fundamentally because of lack of interest.

Supply chain management is the new fad on the block (Coyle et al., 2003) and offers huge opportunities for the application of operations research (as do all highly complex systems), but little research and development in this area is taking place (Benton & Maloni, 1996, p.419). "Despite extensive conceptual based supply chain literature, very few researchers have attempted a more rigorous analytical approach to supply chain issues", (Benton & Maloni, 1996, p.419). Benton and Maloni (1996, p.419) describe laboratory experiments as a part of research into heuristic OR methods for the analysis of supply chain "management processes"; forty-two years after Simon and Newell's (1958, p.1) article on heuristic OR methods there is still only superficial progress being made.

To summarize; the academic value of OR could be impressive, but at the moment not enough interest is being paid to advancing the science of management. It seems that the scientific community has become complacent with using MC tools that have been around for over half a centaury already (Fuller & Mansour, 2003, p.422). It is logical to postulate that the technology of OR (MC) will not advance innovatively unless there is a renewed interest in MS, but even more importantly a renewed interest in ME, the link between MS and MC.

MC (The technology that is OR and its implementation)

OR has birthed a number of tools and techniques that enjoy widespread usage and acclaim (Fuller & Mansour, 2003, p.422). Lane et al. (1993) identifies thirteen "quantitative models of OR" which are: decision analysis models, linear programming models, game theory models, simulation models, network optimization models, project management models, inventory models, queuing models, dynamic programming, integer programming, non-linear programming models, forecasting models and Markov decision models. Each of the above "quantitative models" can be viewed as stand-alone tool that industrial engineers and other members of the scientific community can use to solve a myriad of real-world problems.

Unlike MS, MC is thriving. Steenken et al. (2004, p.3) note in their comprehensive paper on the subject, that "operations are nowadays unthinkable without effective and efficient use of information technology as well as appropriate optimization (operations research) methods". Steenken et al. (2004, p.3) analyze containerization operations management and "present a survey of methods for their optimization". In their conclusion Steenken et al. (2004, p.3) note "the importance of operations research methods in the field of optimizing logistic operations at a container terminal."

The list of possible OR applications seems to be infinite. Turnban (1972, p.708) published an interesting article titled: "A Sample Survey of Operations-Research Activities at the Corporate Level". The article is an exhibition of the versatility of OR and analyses the widespread and diverse practical facet of OR as well as listing numerous examples from industry. The article was published thirty-seven years ago, and computational data processing power has produced many new opportunities for the application of OR in the last decade, let alone since 1972.

Critique of MC

The greatest flaw of OR technology is not the fault of the science itself, but rather it is an inevitable intrinsic characteristic of the field of management which OR seeks to analyze: uncertainty. Management in general is an organic concept with influencing factors ranging from economics and politics through to psychology and sociology (Coyle et al., 2003; Gitlow et al., 2005). OR attempts to model real-life situations as accurately as possible but there are very often just too many variables for the operations researcher to include in the model, and worst of all; the nature of the variables is seldom known with any substantial degree of certainty. OR is a tool that management uses to aid the decision making process, but the results of that decision can only be seen in the future. A consequence is that forecasts, predictions and assumptions of the future state of the universe are a required component of the model – the bane of any scientist whose job is to attain reliable conclusions.

Uncertainty in OR is the single greatest reason why OR does not share in the respect granted to the other applied sciences (where uncertainty has for a large part been eliminated and the well established use of safety factors makes these applied sciences appear to be far superior to OR). The benefit of the inherent complexity of OR is the potential of this discipline, the uncharted waters are beckoning. Bell (1985, p.1) investigates "disappointment in decision making under uncertainty" and proposes to include the purely psychological phenomenon of disappointment in OR models.

The role of OR in IE

Industrial engineering is notoriously difficult to define. The author proposes a concise definition that is accurate but admittedly incomplete and predominantly futile: "IE is the science of making managerial decisions". When tested the definition holds because "management" is in itself a uselessly broad term which can be applied to any system, project or instance in which operational decisions must be made. With this definition in mind the role of OR in IE seems natural; if IE is the science of making managerial decisions and OR contains tools for making managerial decisions then OR is a valuable asset in the repertoire of industrial engineers, regardless of field of specialization. If nothing else, OR has become a valuable and noteworthy "toolbox"; and it is the industrial engineers who study the theory of this technology and practice it.

As a final sentiment on the role of OR in IE; it must be noted that the responsibility of industrial engineers to the advancement of OR cannot be understated. It is the industrial engineer who has studied the subject matter of OR and therefore possesses the ability to postulate new theories, suggest new hypotheses and help to strengthen the link between theory and practice. As the field of OR cannot advance without the academic input of industrial engineers, deontology dictates that it is the ethical responsibility of industrial engineers to strive to make advances in this scientific domain (Harris et al., 2009). The global community of industrial engineers is currently either complacent or waiting for someone else to do the work, and so the field which is the industrial engineer's livelihood stagnates; a sad state of affairs.

Conclusion

Above, a brief history of OR is given which shows the polarization of OR into theory (MS) and practice (MC). Reasons for the polarization are given but only a superficial analysis is given. The drivers and inhibitors of OR development are explained in an historical and contemporary context, and then the current state of OR is briefly examined with reference to the two poles of OR given separately. A critical review of the most prominent defect of OR is given. Finally OR is defined in the context of Industrial Engineering.

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Appendix B: NSPCA Statement of Policy

CONTENTS

NOTE: - Any reference to "The Council" in this document should be taken as meaning the National Council of Societies for the Prevention of Cruelty to Animals (NSPCA), South Africa.

Explanatory notes are available on request.
Attitudes of individuals, as well as of communities and Societies, change from time to time. Therefore what is considered to be an accepted practice to one generation may be condemned by another. Therefore, the following statements must be accepted as representing current thinking but do not bind the Council nor imply any variation from the SPCA Act No 169 of 1993. The subsections listed hereunder are not exhaustive and do not imply the limitation of the Council's concern in regard to matters not specifically mentioned. They represent an attempt to summarise, in an orderly and logical way, the activities of an organisation whose mission is the PREVENTION OF CRUELTY TO ANIMALS.

Although these issues are considered in the South African context, the Council will seek to influence other countries where possible, and may give support to international campaigns for the protection of animals in South Africa and elsewhere in the world**.**

1 STATEMENT OF PRINCIPLES AND BELIEFS

Every living creature has intrinsic value and is a sentient being.
Our primary and motivating concern is the prevention of cruelty to all living creatures. We are mindful that humans have been uniquely endowed with a sense of moral values. For this reason, we believe humans are responsible for the welfare of those animals that they have domesticated and those upon whose natural environment humans encroach. This responsibility, we believe, must be shared by all people. It does not matter if they benefit from the use of such domestic animals or participate in the alteration of environments supporting the life of other creatures. As the dominant and intelligent life form on earth, we

are accountable as a species. Although it is recognised that animals are used in the service of humans, and although we are not opposed to the legitimate and appropriate utilisation of animals in such service, such utilisation gives humans neither the right nor the licence to exploit or abuse any animal in the process.

Our tools will be leadership, education and action. We will achieve this using such legal means as are most effective and are at our disposal. We shall endeavour to promote animal welfare in specific situations and strive to bring about new respect to all living creatures.

GENERAL PRINCIPLES

The NSPCA considers that the welfare of an animal includes its physical and mental state and that good animal welfare implies both fitness and a sense of well-being. The Council believes that an animal's welfare should be considered in terms of five freedoms which form a logical and comprehensive framework for analysis of welfare within any animal use together with the steps and constraints of an effective livestock industry: -

- Freedom from hunger and thirst – by ready access to fresh water and a diet to maintain full health and vigour.
- Freedom from discomfort – by providing an appropriate environment including shelter and a comfortable resting area
- Freedom from pain, injury or disease – by prevention, by rapid diagnosis and treatment.
- Freedom to express normal behaviour – by providing sufficient space, proper facilities and company of the animal's own kind.
- Freedom from fear and distress – by ensuring conditions and treatment which avoid mental suffering.

The Council considers that these freedoms will be better provided for if those who have care of animals practise: -

- Caring and responsible planning and management
- Skilled, knowledgeable and conscientious animal management
- Appropriate environmental design
- Considerate handling and transport
- Humane killing.

DEFINITIONS

- The term "animal" includes all vertebrates other than humans
- The term "suffering" includes stress, fear, pain, discomfort, injury, disease and behavioural distress.

2 FARM ANIMALS

2.1 FARMING PRACTICES / SYSTEMS

The Council is opposed to all forms of farming and animal husbandry practices which cause suffering or distress to animals, or which unreasonably restrict their movements or their behavioural patterns which are necessary for the well-being of the species concerned.

2.2 SLAUGHTER

(a) The Council is opposed to the slaughter of any animals unless they are instantaneously killed, or rendered instantaneously unconscious and insensible to pain prior to the throat being cut and death supervening.

(b) The Council is opposed to the transport of animals for slaughter using unsuitable methods / vehicles.

(c) The Council advocates that food animals should be slaughtered as close to the point of production as possible, in a registered and approved abattoir.

(d) The Council advocates that farm animals which have to be emergency slaughtered, should be humanely and promptly destroyed, on site.

The Council is opposed to the use of any instrument, appliance or device on any animal that is not proved to be necessary and to the benefit of the animal, and which is undertaken without veterinary supervision or instruction/control.

2.3 SALE OF UNWEANED ANIMALS

The Council is opposed to the sale of unweaned animals.

2.4 EXPORT OF LIVE ANIMALS

The Council is opposed to the transport of live animals by sea.

2.5 PHYSICAL ALTERATIONS

The Council is opposed to mutilations or procedures which are performed for non-therapeutic reasons, especially those carried out in an attempt to 'adapt' animals to an inappropriate husbandry system, or overcome problems associated with inappropriate husbandry systems. In such cases it is the system, not the animal, which should be modified.

2.6 BRANDING

The Council is opposed to forms of branding which cause suffering, such as hot iron branding. Where branding is necessary, the Council advocates the use of freeze branding.

2.7 FOOD LABELLING

The Council advocates that the consumer should have the right to know how all animal products (including non-food products) are produced and that they should be labelled with the method of production.

2.8 SYSTEMS DEVELOPMENT

The Council is opposed to the development of systems for farming non-domesticated species which cause or are likely to cause or involve suffering or stress.

2.9 ENHANCEMENT OF PRODUCTION / PERFORMANCE

The Council is opposed to the administration of substances or application of techniques which are intended to enhance the production or performance of an animal and which cause or are likely to cause pain or suffering.

2.10 ACCELERATED GROWTH / PRODUCTION

The Council is opposed to the selection or breeding of animals for accelerated growth rates or enhanced production capacity where this may inhibit normal activity and cause metabolic or skeletal defects, chronic lameness or pain.

2.11 ELECTRO-IMMOBILISATION

The Council is opposed to the electro-immobilisation of animals.

3 COMPANION ANIMALS

3.1 RESPONSIBLE PET OWNERSHIP

The Council discourages the keeping of domestic animals by those who do not have the facilities, time, financial means or level of interest necessary to ensure a satisfactory standard of care and husbandry for their pets.

Since the Council is opposed to any degree of confinement which may cause distress or suffering or which may result in an animal being unable to display or indulge in natural behaviour, inadequate standards for cages commonly accepted for animals – notwithstanding their legality – are discouraged and opposed.

The Council opposes pet animals being offered as gifts or being given as prizes.

The Council opposes the informal sale (hawking) of domestic animals.

3.2 POPULATION CONTROL

The Council advocates the sterilising of animals as early as possible unless there are overriding veterinary reasons to the contrary. The Council advocates the sterilisation of cats and dogs at eight weeks.

3.3 BREEDING

The Council is opposed to the breeding of animals which may produce change in bodily form and/or function which is detrimental to their health or quality of life.

The Council is opposed to uncontrolled private and commercial breeding of puppies, kittens and other animals.

3.4 EUTHANASIA

The SPCA National Council is opposed to the euthanasia of fit and healthy animals but accepts the reality that humane destruction is necessary. Euthanasia must be carried out by qualified personnel using approved and humane methods and with the greatest compassion.

3.5 FERAL CATS

On sites where the welfare of colonies of feral cats is ensured and their presence is accepted by the owners of the site, the Council advocates the sterilisation of such cats, provided that instructions concerning humane procedures are followed, as may be prescribed by the Council.

3.6 PET SHOPS

The Council is opposed to the donation or sale of all live animals to pet shops or similar outlets / operations. The Council opposes the sale of live animals by pet shops, through the means of the Internet and by any long-distance "brokering".

3.7 SURGICAL MUTILATIONS

The Council is opposed to the unnecessary mutilation of animals: - for cosmetic, sporting, entertainment or convenience purposes - including but not limited to tail-docking, ear-cropping, de-barking, de-clawing and myotomy.

The Council takes the identical standpoint relating to the various surgical mutilations of other species.

4 ANIMAL EXPERIMENTATION

4.1 PAIN AND SUFFERING IN EXPERIMENTS

The Council is opposed to all experiments or procedures which cause pain, suffering or distress.

4.2 UNNECESSARY EXPERIMENTS

The Council is opposed to animal experiments which involve unnecessary repetitions or are for scientifically trivial ends or which involve techniques to which satisfactory and humane alternatives have already been developed. The Council is also opposed to the use of animals in the testing of inessential substances such as cosmetics.

4.3 HUMANE ALTERNATIVES

The Council supports the development of techniques that will result in the replacement, reduction or refinement of animal experimentation (the concept of the "3 Rs"). The Council regards as an advance any technique that will completely replace the use of animals, reduce the numbers used or reduce suffering.

4.4 LABORATORY ANIMAL SUPPLY

The Council is opposed to the import and export of laboratory animals.

The Council is strongly opposed to the use of wild-caught animals of any species regardless of their conservation status.

5 TRANSPORT OF UNACCOMPANIED ANIMALS

5.1 The Council is opposed to any animal being posted / mailed and opposes the transportation of animals in containers or vehicles unsuitable to the animal(s). The Council advocates that no animal shall be transported in any manner or under such conditions that may cause suffering.

5.2 The Council is opposed to the transporting of companion animals in open bakkies.

5.3 The Council is opposed to animals being left in vehicles unattended.

6 ANIMALS FOR EXHIBITION, ENTERTAINMENT OR SPORT

6.1 CAPTIVE ANIMALS

The Council is opposed to any degree of confinement or the use of any animal in sport, entertainment or exhibition likely to cause distress or suffering or which may adversely affect the animal's welfare.

The Council is totally opposed to exhibitions or presentations of wild animals in circuses and travelling menageries.

6.2 ANIMALS IN PERFORMANCE OR EXHIBITION

The Council opposes the portrayal of any action depicting irresponsible behaviour towards animals, condoning irreverence or disrespect towards animals as perceived by the viewer.

The Council opposes the non-documentary depiction of any violation of the Animals Protection Act or any issue contrary to the Statement of Policy.

6.3 EQUESTRIAN DISCIPLINES

The Council opposes any practices that cause unnecessary suffering to equine albeit during training or during the actual event.

6.3.1 The Council opposes horse racing in any form.

6.4 HUNTING AND FISHING

The Council does not believe that sport justifies causing suffering to animals and therefore is opposed to the hunting or fishing of any animal for sport, recreation or entertainment.

The Council stands opposed to current practices undertaken by commercial fishing and seeks the development of more environmentally friendly and eco-sensitive fishing techniques. The Council is opposed to drift-net and gill-net fishing and the indiscriminate use of any fishing equipment which catches non-target species.

The Council opposes inhumane methods used to kill lobsters, crabs, crayfish, squid and octopus.

6.5 LIVE PREY

The Council opposes the feeding of live prey.

6.6 LIVE ANIMALS AS PRIZES

The Council opposes the practice of live animals being given as prizes in raffles and competitions or as fund-raising events.

6.7 RODEOS

The Council is opposed to rodeos and animal chases.

6.8 ANIMAL COMBAT

The Council is opposed to the use of animals in any form of combat whether against man or animal.

6.9 BLOOD SPORTS

The Council is opposed to any degree of pain and suffering or distress on any animal in the name of sport and / or human entertainment. The Council believes that sport does not justify the causing of suffering to animals and therefore the Council is opposed to shooting for sport.

6.10 ANIMAL RACING

The Council opposes animal racing in any form.

7 WILDLIFE

7.1 WILD ANIMALS

The Council is opposed to the taking or killing of wild animals, or the infliction of any suffering upon them.

7.2 The Council is opposed to the unnecessary killing of wild terrestrial and aquatic animals.

7.3 The Council opposes the practice of removing offspring from parent(s) for the purpose of hand-rearing.

7.4 SNARES AND TRAPS

The Council is opposed to the manufacture, sale and use of all snares and any trap or trapping device or substance or form of animal control which causes or may cause suffering.

7.5 POISONS

The Council is opposed to the use of poisons and has specific concerns about the widespread agricultural and commercial use of chemical substances which are potentially harmful to animals.

7.6 WHALING

SPCA is against the killing of whales.

7.7 IMPORTING AND EXPORTING OF WILD ANIMALS

The Council is opposed to the trade in wild animals and to the trading of products derived from wild animals where distress or suffering may be caused.

7.8 HYBRIDS

The Council opposes the hybridisation of wild species with domesticated animals for the purpose of creating new breeds of companion animals and opposes the hybridisation of wild animals for the purposes of hunting.

7.9 BREEDING AND KEEPING AS PETS

The Council is opposed to the breeding and keeping of exotics and wild animals as pets.

8 ANIMALS IN EDUCATION

The Council is opposed to the use of animals for education if distress or suffering are likely to be caused or unless an explicit animal welfare rationale for keeping the animals can be demonstrated.

8.1 DISSECTION

The Council is opposed to the practice of dissection of vertebrate and invertebrate animals in schools.

8.2 BEHAVIOURAL EXPERIMENTS

The Council is opposed to behavioural experiments which are detrimental to the welfare of animals.

9 GENETIC ENGINEERING

9.1 The Council is opposed to the manipulation of the genetic constitution of animals which causes pain, suffering and distress.

The Council believes that the production of genetically modified animals for potential uses in science, medicine and agriculture has serious animal welfare and ethical implications. In particular, the Council is concerned about the suffering caused to both the genetically modified animals themselves and the animals used in their production.

9.2 The Council is opposed to the breeding and or manipulation of animals that results in patenting.

10 WORKING ANIMALS

The Council does not stand opposed to working animals subject to welfare standards being met.

Appendix C: Standard Operating Procedures for Admissions

Animals are admitted to the SPCA within any of the following categories:

- ❏ Strays public
  SPCA collection
- ❏ Unwanted; public
- ❏ Abandoned – SPCA collection
- ❏ Impounded- Municipal By- laws; SPCA collection
- ❏ Confiscation- APA, 71 of 1962 SPCA collection
- ❏ Treatment- private public
  Alimoning; public
- ❏ Boarding. Public

5.1 <u>STRAY ANIMALS</u>

Stray animals have to be reclaimed by the rightful owner within 7 days after which release from pound is effected as per adoption procedure.

PUBLIC office hours

- ❏ Animal checked at admission point/ clinic;
- ❏ Check for ID or microchip;
- ❏ Enter onto system/ form (filed into register)
  - Name, residential address and contact number of finder;
  - Time and date that animal was found;
  - Place where animal was found;
  - Description of animal : age, breed, colour, sex, distinctive markings or injuries, size of the animal;
  - Time and date of admission onto system/ form.
- ❏ Veterinary services to check, note findings, if any, on system/ form and allocate kennel.
- ❏ Kennel form attached to the relevant kennel;

SPCA COLLECTION, office hours

- ❏ Animal checked at admission point/ clinic;
- ❏ Check for ID or microchip;
- ❏ Enter onto system/ register
  - Name, residential address and contact number of caller where relevant;
  - Time and date that animal was collected;
  - Place where animal was collected;
  - Description of animal: age, breed, colour, sex, distinctive markings or injuries, size;
  - Time and date of admission into system/ register.
- ❏ Veterinary services to check, note findings, if any, on system and allocate kennel.
- ❏ Kennel form attached to the relevant kennel

PUBLIC after hours

- ❏ Animal checked at admission point/ by officer on duty ;
- ❏ Check for ID or microchip;
- ❏ Officer on duty refers to systems operator to enter onto system/ register, supplies following:
  - Name, residential address and contact number of finder;

- Time and date that animal was found;
- Place where animal was found;
- Description of animal: age, breed, colour, sex, distinctive markings or injuries, size;
- Time and date of admission into system/ register.

❏ If animal is injured, officer on duty will take appropriate action immediately;
❏ Referred to Veterinary services the next morning to check, note findings, if any, on system and allocate kennel.
❏ Kennel form attached to the relevant kennel;

SPCA COLLECTION, after hours

❏ Driver/ inspector brings animal to admission point/ clinic;
❏ Check for ID or microchip;
❏ Officer on duty refers to systems operator to enter onto system/ register, supplies following:
- Name, residential address and contact number of finder;
- Time and date that animal was found;
- Place where animal was found;
- Description of animal: age, breed, colour, sex, distinctive markings or injuries, size;
- Time and date of admission into system/ register.

❏ If animal is injured, officer on duty will take appropriate action immediately;
❏ Referred to Veterinary services the next morning to check, note findings, if any, on system and allocate kennel.
❏ Kennel form attached to the relevant kennel;

LIVESTOCK AND WILD LIFE

❏ All livestock and wildlife are referred to Special Operations Unit;
SPU check animals and complete Description of animal: age, breed, colour, sex, distinctive markings or injuries, size;
❏ Provide details to systems operator for entry onto system/ register.
❏ Refer any injured or diseased animals to clinic;
❏ Monitor animals

NOTE
Reception needs to notify the inspector should the animal be admitted for a second time. The inspector is responsible for educating/ advising the owner on possible actions to remedy the situation;

Should the animal be admitted for third time an inspector issues the owner with a warning in terms of section 30(1) (2) of the relevant Municipal by- laws?

5.2 UNWANTED ANIMALS

PUBLIC office hours

❏ Animal checked at admission point/ clinic;
❏ Check for ID or microchip, verify ownership;
❏ Owner to sign all documents;
❏ System controller enters onto system/ register
- Name, residential address and contact number of owner;
- Description of animal: age, breed, colour, sex, distinctive markings, injuries, size;
- Time and date of admission into system/ register.

❏ Veterinary services to check, note findings, if any, on system;

❑ Kennel form attached to the relevant kennel.

PUBLIC after hours

❑ Animal checked at admission point/ by officer on duty ;
❑ Check for ID or microchip verify ownership;
❑ Owner to sign all documents;
❑ Officer on duty refers to systems operator to enter onto system/ register, supplies following:
- Name, residential address and contact number of owner;
- Description of animal: age, breed, colour, sex, distinctive markings or injuries, size;
- Time and date of admission into system/ register.

❑ If animal is injured or diseased, officer on duty will take appropriate action immediately
❑ Referred to Veterinary services the next morning to check, note findings, if any, on system ;
❑ Veterinary services to check, note findings, if any, on system
❑ Kennel form attached to the relevant kennel;

5.3. IMPOUNDED ANIMALS

Where the owner of the impounded animal is known the inspector needs to communicate with Metro Police, who issues the owner with an impoundment notice and fine in terms of the relevant section 30(1) (2) of the relevant Municipal by- laws.

❑ Impounding officer to have Animal checked at admission point/ clinic;
❑ Check for ID or microchip, verify ownership;
❑ Inspector to ensure that all documentation is in order and to sign admission form;
❑ System controller enters onto system/ register
- Name, residential address and contact number of owner;
- Description of animal: age, breed, colour, sex, distinctive markings or injuries, size;
- Time and date of admission into system/ register.
- Reason for impoundment, relevant Sections of By- laws;

❑ Kennel form attached to the relevant kennel
❑ Veterinary services to check, note findings, if any, on system
❑ Keep for period as per specified conditions of impoundment,
- inspector to keep Veterinary services informed,
- make notes on kennel forms as to progress and timeframes;

❑ After pound period inspector needs to advise Veterinary services of further action;
❑ If the animal is impounded after hours and the Officer on duty is of the opinion that the animal requires immediate veterinary care then it will be provided. The said veterinarian will submit a report after investigating and substantiating the officer's actions.

5.4 C0NFISCATED ANIMALS

❑ Confiscating officer to have Animal checked at admission point/ clinic;
❑ Check for ID or microchip, verify ownership;
❑ Inspector to ensure that all documentation is in order and to sign admission form;
❑ System controller enters onto system/ register
- Name, residential address and contact number of owner;
- Description of animal: age, breed, colour, sex, distinctive markings or injuries, size;
- Time and date of admission into system/ register.
- Reason for confiscation, relevant Sections of APA;

- Case number (a Docket needs to be opened)

❑ Kennel form attached to the relevant kennel;
❑ Veterinary services to check, note findings, if any, on system ;
❑ Keep for period as determined by investigations/ court procedure,
- inspector to keep Veterinary services informed as to progress with case,
- make notes on kennel forms as to progress and timeframes ;

❑ After pound period inspector needs to advise Veterinary services of further action;
❑ Keep for period as per progress of case, court hearings and trial,
- inspector to keep Veterinary services informed,
- make notes on kennel forms as to progress and time frames;

❑ Inspector needs to advise Veterinary services of progress or further action;
❑ If the animal is confiscated after hours and the Officer on duty is of the opinion that the animal requires immediate veterinary care then it will be provided. The said veterinarian will submit a report after investigating and substantiating the officer's actions.

5.5 TREATMENT ANIMALS

5.5.1 OUT PATIENTS- Day visitors (Vaccinations, Minor treatments)

Reception

❑ Clients with animals for treatment report to reception;
❑ Reception checks record of client
❑ Ascertain whether client qualifies as alimoning or private, client to complete prescribed form and produce proof of income;
❑ If new client register on system and opens a file,
❑ Admit animal on system and gives client admission form;
❑ Client waits in waiting room for consultation

Clinic

❑ Veterinarian summons client and animal;
❑ Client gives Vet admission form;
❑ Vet examines animal and makes diagnosis;
❑ Vet enters diagnosis on system with notes,
❑ Treats and dispenses drugs, makes notes on system and admission form or has animal admitted for hospitalization;
❑ If hospitalized, owner has to complete "**anaesthetic consent form"**
If animal can be discharged vet does costing, makes notes on admission form
❑ Reception receipt money as indicated by vet;
❑ Reception files relevant forms for future reference.

5.5.2 OUT PATIENTS - *IF ANIMALS ARE HOSPITALIZED*

❑ Clients with animals for treatment report to reception;
❑ Reception checks record of client
❑ Animal is allocated kennel on system, admission form accompanies animal
❑ Daily treatments and drug use and relevant note kept on system
❑ Owner has to complete "**anaesthetic consent form"**

- ❏ At discharge animal is released from system
- ❏ Printouts of notes attached to Admission form,
- ❏ Vet does costing makes notes on admission form
- ❏ Reception receipt money as indicated by veterinarian;
- ❏ Reception files relevant forms for future reference.

5.6 BOARDING ANIMALS

- ❏ Advance reservation for boarding essential;
- ❏ The full boarding fee is payable on the day of admission. (*Boarding fees are calculated per night, except where animals are collected after 12:00- where a full day's fee is charged*.)
- ❏ Owners have to present an up to date vaccination certificate before animals can be accepted;
- ❏ Owners must complete the prescribed admission form and provide the following information upon admission of their animals
    - Name, residential address and contact number of owner or other responsible person;
    - Name and contact number of veterinarian;
    - Address and contact number of owner during time of absence;
    - Description of animal: age, breed, colour, sex, distinctive markings or injuries, size.
- ❏ The animal must be admitted on to the system and assigned a kennel number, admission form must be attached to the kennel;
- ❏ The following animals cannot be accepted:
    - Animals younger than six (6) months
    - Animals under medication or chronic treatment;
    - No pregnant or whelping / lactating bitches/ queens;
    - Injured or sick animals.
- ❏ Period of boarding may not exceed thirty (30) continuous days;
- ❏ Animals in boarding can only be collected during office hours.
- ❏ Animals not collected within five (5) working days after collection date, without prior arrangement will be regarded as abandoned and will become the property of the pound, the owner will still be held liable for any outstanding costs;
- ❏ At it's discretion the SPCA is entitled to engage any veterinary or other services in the animals interest at the expense of the owner;
- ❏ The owner needs to sign the prescribed indemnity, reception staff are to make sure that the client understands the terms and conditions of boarding their animals at the SPCA.

Appendix D: Complete process list for original admissions SOP

Process_Stray_AdmissionCheck1
Process_Stray_AdmissionCheck2
Process_Stray_AdmissionCheck3
Process_Stray_AdmissionCheck4
Process_Unwanted_AdmissionCheck1
Process_Unwanted_AdmissionCheck2
Process_Impounded_AdmissionCheck
Process_Confiscated_AdmissionCheck
Process_Stray_AfterHoursTreatment3
Process_Stray_AfterHoursTreatment4
Process_Unwanted_AfterHoursTreatment2
Process_Impounded_AfterHoursTreatment
Process_Confiscated_AfterHoursTreatment
Process_Stray_Animal_Placed_in_AdoptionKennel1
Process_Stray_Animal_Placed_in_AdoptionKennel2
Process_Stray_Animal_Placed_in_AdoptionKennel3
Process_Stray_Animal_Placed_in_AdoptionKennel4
Process_Unwanted_Animal_Placed_in_AdoptionKennel1
Process_Unwanted_Animal_Placed_in_AdoptionKennel2
Process_Impounded_Animal_Placed_in_AdoptionKennel
Process_Confiscated_Animal_Placed_in_AdoptionKennel
Process_Stray_Animal_Placed_in_PoundKennel1
Process_Stray_Animal_Placed_in_PoundKennel2
Process_Stray_Animal_Placed_in_PoundKennel3
Process_Stray_Animal_Placed_in_PoundKennel4
Process_Impounded_Animal_Placed_in_PoundKennel
Process_Confiscated_Animal_Placed_in_PoundKennel
Process_Stray_AnimalRegistration1
Process_Stray_AnimalRegistration2
Process_Stray_AnimalRegistration3
Process_Stray_AnimalRegistration4
Process_Unwanted_AnimalRegistration1
Process_Unwanted_AnimalRegistration2
Process_Impounded_AnimalRegistration
Process_Confiscated_AnimalRegistration
Process_Boarding_AnimalRegistration
Process_Stray_Check_for_ID_or_Microchip1
Process_Stray_Check_for_ID_or_Microchip2
Process_Stray_Check_for_ID_or_Microchip3
Process_Stray_Check_for_ID_or_Microchip4
Process_Unwanted_Check_for_ID_or_Microchip1
Process_Unwanted_Check_for_ID_or_Microchip2
Process_Impounded_Check_for_ID_or_Microchip
Process_Confiscated_Check_for_ID_or_Microchip
Process_Stray_Form_Attached_to_Relevant_Kennel1
Process_Stray_Form_Attached_to_Relevant_Kennel2
Process_Stray_Form_Attached_to_Relevant_Kennel3
Process_Stray_Form_Attached_to_Relevant_Kennel4
Process_Unwanted_Form_Attached_to_Relevant_Kennel1
Process_Unwanted_Form_Attached_to_Relevant_Kennel2
Process_Impounded_Form_Attached_to_Relevant_Kennel

Process_Confiscated_Form_Attached_to_Relevant_Kennel
Process_TreatAnimal_Form_Attached_to_Relevant_Kennel
Process_Boarding_Form_Attached_to_Relevant_Kennel
Process_Stray_OvernightPlacement3
Process_Stray_OvernightPlacement4
Process_Unwanted_OvernightPlacement2
Process_Impounded_OvernightPlacement
Process_Confiscated_OvernightPlacement
Process_Stray_VetCheck_and_KennelAllocation1
Process_Stray_VetCheck_and_KennelAllocation2
Process_Stray_VetCheck_and_KennelAllocation3
Process_Stray_VetCheck_and_KennelAllocation4
Process_Unwanted_VetCheck_and_KennelAllocation1
Process_Unwanted_VetCheck_and_KennelAllocation2
Process_Impounded_VetCheck_and_KennelAllocation
Process_Confiscated_VetCheck_and_KennelAllocation
Process_Unwanted_Get_Owner_Signatures1
Process_Unwanted_Get_Owner_Signatures2
Process_Unwanted_Vaccination1
Process_Unwanted_Vaccination2
Process_Impounded_InspectorDocumentation
Process_Confiscated_InspectorDocumentation
Process_Impounded_PoundInspector_informs_VetServices_of_further_action
Process_Confiscated_PoundInspector_informs_VetServices_of_further_action
Process_Impounded_VetReport_OfficerActions
Process_Confiscated_VetReport_OfficerActions
Process_TreatAnimal_AnaestheticConsentForm1
Process_TreatAnimal_AnaestheticConsentForm2
Process_TreatAnimal_Costing1
Process_TreatAnimal_Costing2
Process_TreatAnimal_FinalDocumentation1
Process_TreatAnimal_FinalDocumentation2
Process_TreatAnimal_Payment1
Process_TreatAnimal_Payment2
Process_Boarding_Payment
Process_TreatAnimal_RecordCheck1
Process_TreatAnimal_RecordCheck2
Process_Impounded_LawApplication
Process_TreatAnimal_AdmissionDocumentation
Process_TreatAnimal_Diagnosis
Process_TreatAnimal_KennelAllocation
Process_TreatAnimal_OpenFile
Process_TreatAnimal_PrintNotes
Process_TreatAnimal_Proof_of_Income
Process_TreatAnimal_Treatment
Process_TreatAnimal_Treatment_and_Notes
Process_Boarding_Boarding
Process_Boarding_CheckVaccinationStatus
Process_Boarding_ExtraPayment
Process_Boarding_ExtraWaitForNothing
Process_Boarding_ExtraWaitForOwners
Process_Boarding_IndemnityForm
Process_Boarding_Reservation
Process_Boarding_WaitForOwners

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Appendix F: NSPCA intellectual property release form

Permission is granted to the author of this document to use the intellectual property of the NSPCA contained herein for the sole purpose of attempting to achieve the stated goals of the project.

Permission to use the intellectual property contained within this document may be rescinded at any time at the discretion of the NSPCA.

Mr. C. Allan
Managing Director
Tshwane SPCA

5 October 2010