

IMPROVEMENT OF PROJECT MANAGEMENT SYSTEMS

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*A report submitted in partial fulfilment of the requirements for the Degree*

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*in the University of Canterbury*

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## Abstract

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With Falcon Electrical's current growth, and the increasing size, complexity and diversity of projects undertaken, it has become necessary to improve the Project Management systems and abilities within the company. The systems in place increase effectiveness of a project's delivery from concept through to completion. Improvements in these systems were determined as where value can be added to future projects and the on-going service work performed by Falcon Electrical. This report highlights the frameworks for improvement, and how these were integrated with the existing systems at Falcon Electrical and other tasks performed.

## Acknowledgements

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I would like to thank Richard Phillips, Managing Director of Falcon Electrical, for undertaking this project, and the support provided by the managers at Falcon Electrical through the duration of the project.

Also I would like to thank the many other employees at Falcon for imparting their knowledge and experience in working on projects throughout the industries Falcon Electrical operates within.

Finally to Piet Beukman and Beverly Hall, I thank them for their commitment to this course and the value it has provided our class.

## Document Revision

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## Executive Summary

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The project was sponsored by Falcon Electrical Limited and was undertaken between 7<sup>th</sup> October 2013 and 31<sup>st</sup> January 2014. It has been undertaken as part of Falcon Electrical's drive to improve its processes and systems for the management of projects. It has provided the intern with experience in most aspects of commercial and industrial electrical and automation projects.

Greiner's growth curve indicates that the most desirable position to develop formal project management systems and quality management systems (QMSs) is at or before the crisis of autonomy (1). Falcon Electrical has seen a loss of continuity through projects in recent years due in some part to the absence of employees or employee turnover.

Literature has indicated the value of implementing a project management system includes (but not limited to):

- Standardising practices across departments
- Continuity when staff are absent
- Continuity of projects
- Management and control of deviations from the plan
- Process repeatability

If this process is placed within a QMS, impacts include:

- Improved traceability
- Reduced wastage and defects
- Increased employee involvement

Based on multiple case studies and industry experiences, key success factors for both QMSs and project management systems include:

- Employee commitment
- Communication
- Identification of leadership
- Cost of development
- Cost of implementation
- Company culture

In addition, two other key success factors have been identified as important to the implementation of project management systems:

1. **Continual improvement:** Literature suggests the use of discontinuous changes in business processes often does not deliver the desired outcomes over the medium to long term. It is

recommended the use of a continual improvement system is used to implement changes to processes at Falcon Electrical.

- 2. Change management cycle:** The use of a recognised change management cycle such as the Plan-Do-Check-Act cycle will increase the effectiveness of the change process.

The time frame of this project meant that communication with employees played a significant role in determining outputs. Initial review and familiarisation with the scope of works and project management procedures provided insight into Falcon Electrical's procedures. Employees and customers then presented factors which led to success (or failure) of projects:

**Table 1: Factors contributing to success or failure of projects.**

<b>Successful projects involve:</b>	<b>Poorly performed projects involve:</b>
Clear project definition	Lack of ownership of the project
A good understanding of the technical engineering onsite.	Scoping and requirements not understood or recorded
Project involvement or buy-in from client	Customers unaware of their full requirements
Well communicated scopes of work to onsite electricians	Poor project closeout processes where final documentation is often not passed onto the client

The following frameworks were examined with their respective strengths and weaknesses analysed.

- PMBOK – Project Management Body of Knowledge
- PRINCE2 – Project Management Framework
- Agile Project Management (Scrum)

The above project management methodologies were used as frameworks and guides for all documentation and processes developed. Some of the documentation-heavy aspects of PRINCE2 and PMBOK had to be significantly tailored to enable cost effective administration and management of projects. Scrum project management (a form of Agile project management) was shown to be a more suitable framework for software projects needing to be developed with speed. However, this approach is not recommended for production critical automation installations.

All documents and processes developed had to work within the existing SimPro software that manages the quote generation, materials ordering and administration of projects at Falcon Electrical. This software is extremely powerful for administration purposes and very useful, however, it does not allow for the 'soft' (human) side of project management very well.

An obstacle to the implementation of project management systems was the existing structure of data relating to specific projects and customers. In order for effective management, data had to be restructured and organised in a consistent manner to improve access. The clarification and definition of processes for handling customer information will set standards for Falcon Electrical as it seeks to gain ISO9001 accreditation.

Recommendations:

In order for Falcon Electrical to gain the full benefits of the systems and processes introduced the following steps must continue to be acted on:

1. Training – Ensure all employees are aware of project management processes and other processes introduced through the ISO9001 accreditation process. Encourage staff to ask for help when unsure on their tasks and responsibilities. Continue to educate and involve all staff on the correct use of SimPro software and other documentation process surrounding projects and project management.
2. Review – During and at the completion of projects, review which systems and procedures provided value and allowed for a more effective execution of the project. Ensure valuable processes are documented and other employees are informed of these tools / techniques.
3. Culture – Continue to develop a company culture which strives for excellence, and ensure open and clear communication of the company direction is communicated to all involved with managing projects across the business units of Falcon Electrical. Success should also be celebrated loudly, and failure criticized quietly.
4. Discipline – Managers must lead by example. They must be disciplined on all fronts relating to performance of business processes. If these managers do not lead, employees will see no reason for them to follow procedures.
5. Auditing – Projects should be audited at random, with attention being paid to the performance of a project (time, scope, cost, quality). If projects have not met the customers' expectations, or Falcon Electrical has not profited from the project, investigate whether processes have been skipped, or communication breakdowns have occurred. Plans should then be developed as to how this can be avoided in future projects.

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## Nomenclature

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Agile	When used alone this refers to Agile Project Management - Scrum Methodology. Explained in 3.4 Agile Project Management Methodology
HMI	Human Machine Interface - Used to communicate information from SCADA systems or PLC systems. These typically display key outputs, faults and information from the systems they are representing.
ISO9001	A Quality Management System to help organisations ensure they meet the needs of their customers and other stakeholders while meeting regulatory requirements relating to the products.
PDCA	Plan-Do-Check-Act cycle
PLC	Programmable Logic Controllers - Used for industrial and commercial applications to control machinery
PMBOK	Project Management Body Of Knowledge - A framework formed in 1989 to standardise project management concepts and the causal relationships that relate these concepts.
Prince2	A project management methodology developed after PMBOK which also seeks to standardise the project management.
QMS	Quality Management System(s)
SCADA	Supervisory Control And Data Acquisition - Used to oversee networked PLCs and industrial machinery - this typically has a process view of entire factories or areas within factories.
Turnkey	A type of project that is constructed so that it could be sold to any buyer as a completed product

# 1 Introduction to Falcon Electrical

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## 1.1 *Falcon Electrical's Business*

Falcon Electrical provides a range of electrical products, services and solutions to a variety of local, national and Australian customers. Falcon has grown to over 40 staff working 5 business units (listed below). An overview of the services Falcon Electrical provides is listed below:

- **Automation:**  
This business unit performs the design, construction, programming and maintenance of industrial controllers. This includes a variety of PLC controllers with SCADA and HMI integration.
- **Electrical Contracting (Industrial and Commercial):**  
This unit provides Low Voltage (LV) and High Voltage (HV) electrical contracting services. This includes performing installations for heavy industrial sites and commercial sites and projects in new and existing buildings (retrofits/upgrades).
- **Renewable Energy:**  
A recent development at Falcon Electrical – this business unit provides alternative energy solutions (both solar and hydro power generation).
- **Security, Fire and Data:**  
Security, Fire and Data (SFD) provides solutions for security systems (camera surveillance and intrusion detection) coupled with access controls to increase security around clients' business and residential premises. SFD also provide data networking installation services and the installation, maintenance and certification of Fire Detection systems.
- **Switchboards:**  
This division at Falcon Electrical provides design, manufacturing and installation services of switchboards from light commercial to heavy industrial, large scale power distribution boards. This includes Power Distribution Centres (PDC) and Motor Control Cabinets (MCC).

## 1.2 Business Structure

Falcon Electrical is structured so that it can provide both turnkey electrical engineering services for small, medium and large projects involving one or more of its divisions. It is also structured so that it can provide on-going maintenance and support services to its customers. The organisational chart below shows the business units within Falcon and the key tasks they perform.

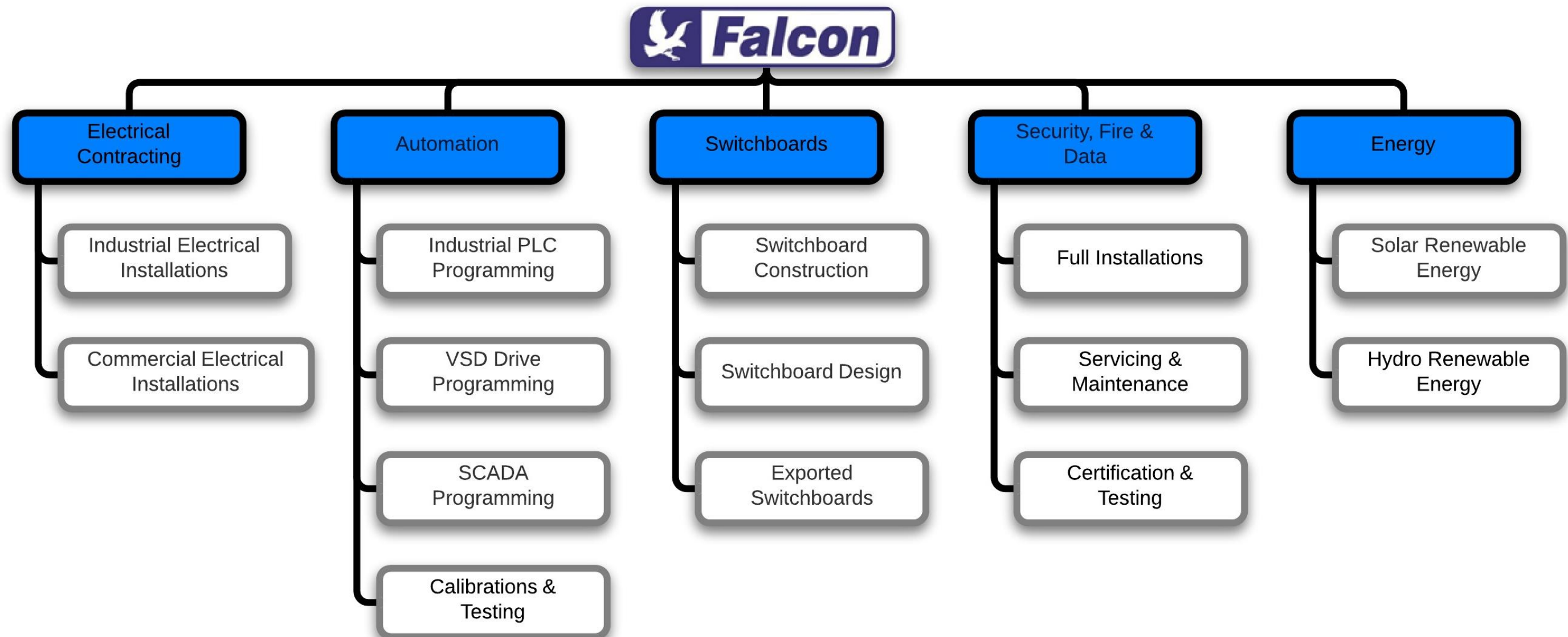


Figure 1: Organisational chart for Falcon Electrical

Effective co-ordination and integration within the business units at Falcon Electrical is key to the success of projects which span multiple forms of electrical related industries. This is part of providing a complete solution to clients and contractors.

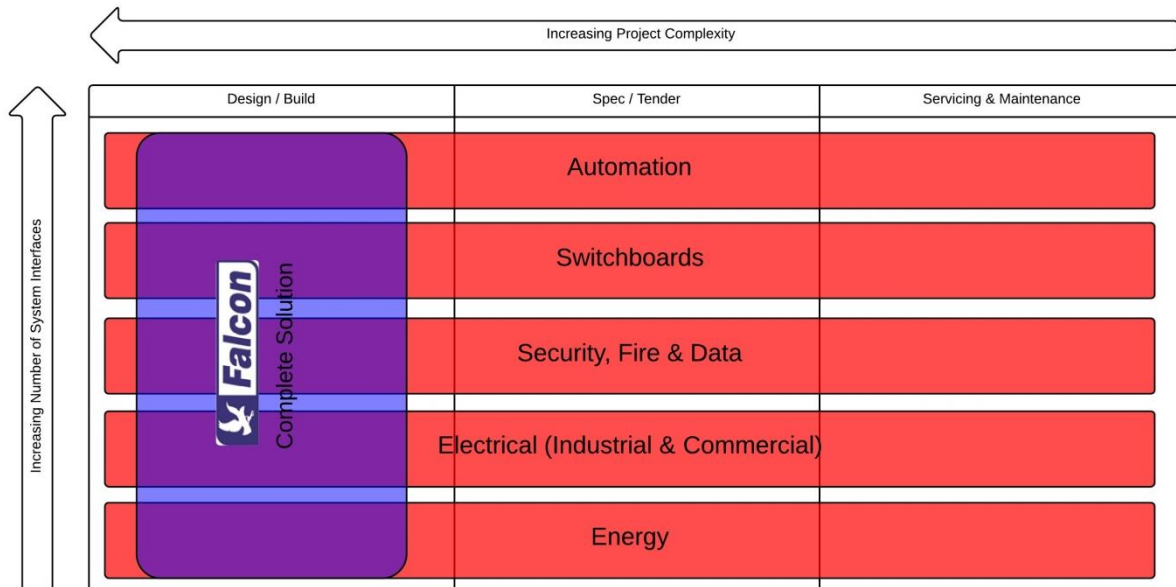


Figure 2: The number of systems needing integration into project solutions increases the project complexity.

## 2 Project Overview

### 2.1 Purpose

The purpose of this project is to review the current project management capabilities and associated business processes at Falcon Electrical and to recommend improvements to enhance the Falcon Electrical project management processes. The project involves presenting findings and implementing recommendations to Falcon Electrical employees and systems.

### 2.2 Background and Justification

Falcon was established in 1975, initially focusing on industrial switchboard design and construction. Falcon Electrical has diversified to improve the stability and profitability of the business. The company has grown organically and increased the range of services it provides to customers. In addition to switchboard design and construction, Falcon Electrical now provides automation, electrical contracting, renewable energy, security, fire and data services highlighted in Figure 1 on page 2.

The wide variety of services and projects Falcon Electrical now provides to customers has led to some difficulties in project management. The lack of a common system, and formal business processes between departments has led to lower than desired levels of service by Falcon Electrical.

The Masters of Engineering Management Project (MEM Project) investigates and makes recommendations of how Falcon Electrical can improve its business processes and project management abilities.

## **2.3 Project Objectives**

This MEM Project will provide Falcon Electrical with an objective perspective on the existing business processes and project management abilities. Formal business processes will be introduced into the project management system at Falcon Electrical. The project management system will be based on established methodologies, with systems and sub-systems tailored to the company's needs. Any developed system should align with:

- Company goals and visions
- Commercial needs of the company
- Client requirements and desired service levels

The project management system will apply across the different services at Falcon Electrical. This will include both electrical servicing and design / construction services. The standardisation process needs to include documentation and the interactions between employees of Falcon Electrical as a project moves from concept, tender and design through to construction, commissioning and billing.

## **2.4 Project Scope**

### **2.4.1 Initial project familiarisation and planning**

The initial project familiarisation and planning includes:

- Develop and refine project plan and organise the project operating conditions
- Understand the business operating environment and the effects of the project on the company
- Review and understand existing internal information systems and business processes associated with projects within the service categories of Falcon Electrical:
  - Solar Energy
  - Security, Fire and Data
  - Automation and Process Control
  - Switchboard Construction
  - Electrical Contracting and Servicing

### **2.4.2 Business Process Research - Project Management**

- Discussions with staff to identify the ideal project outcomes and their requirements and recommendations for improvements in the business processes.

- Research into common causes of faults (communication, unclear customer requirements etc.) and areas of difficulty commonly faced with the business processes.
- Review and analyse the existing project management process within Falcon Electrical and how projects are managed from concept through to completion and servicing.
- Recommend and discuss options to project sponsor, then decide on a project management system and environment that will enable Falcon Electrical to increase the level of performance on the wide range of projects it completes.

#### **2.4.3 Project Management Process Integration**

- Develop a set of systems and subsystems that will integrate, improve and formalise the project management abilities of the company.
- The systems will involve:
  - Formalisation of business processes
  - Formalisation of Project Management aspects.
- Create an implementation plan, and with approval of the sponsor, this will be implemented over the remainder of the project period.

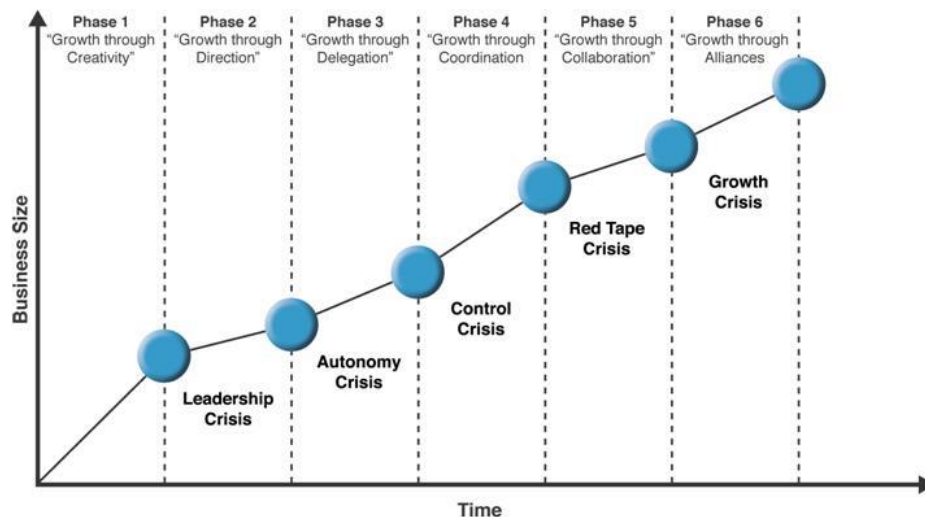
### **2.5 Methodology**

A combination of approaches is used to develop an effective project management system. The combination involves PMBOK, PRINCE2 and Agile Project Management to develop the documentation requirements for project management. The project management processes are developed within a Quality Management System (QMS) that is aimed towards achieving ISO9001.

## **3 Project Management Systems – how & when these should be developed**

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As a business grows there are a series of crises which must be overcome through actions and system developments (1). Figure 3 shows the stages and challenges that must be overcome in order for a business to continue to grow.



**Figure 3: Business growth phases and the associated challenges (2).**

Ideally a Quality Management System and associated Project Management System should be developed as the business seeks 'Growth through Direction' (3). Currently Falcon Electrical will benefit from the use of a formal project management system to implement more structured controls as the company develops through the autonomy crisis and phase 3 – growth through delegation (4). The benefits of a project management system are highlighted below in 3.2 Project Management Manual (PMM) and Associated Value.

### **3.1 Significance of Quality Management Systems**

The QMS, of which the project management system is a part, provides guidance for the development of methods used in the project management system. Quality management is defined as the overall management functions determining the organisation's quality policy, objectives and its responsibilities, as well as the quality policy implementation through means such as quality assurance (5). Studies have shown QMS, such as ISO9001 could benefit Falcon Electrical in the in the following areas (6):

- A decrease in the number of customer complaints.
- An increase in repeat customers.
- A reduction in re-work and associated costs
- Improved control of processes

### **3.2 Project Management Manual (PMM) and Associated Value**

Project management is the application of knowledge, skills and techniques to execute projects effectively and efficiently (7). A standardised project management system such as the Project Management Body of Knowledge (PMBOK) provides value through (8):

- Allowing companies to standardise practices across departments



- Allowing crossover and collaboration with other companies as they will often use the same practice
- Allowing continuity when staff are absent and continuity of projects
- Improving management and control of deviations from the plan
- Increasing the project management skills and competencies at all levels of the organisation.

### 3.3 Overview of PMBOK Framework

This project management methodology focuses on 9 'knowledge areas.' These areas are each associated with operational functions involved with managing projects (7).

**Table 2: PMBOK components (4).**

<b><u>Knowledge Area</u></b>	<b><u>Components</u></b>
Project Integration Management	Project charter Project management plan Monitor and control project work Integrated change control Close project or phase
Project Scope Management	Collect requirements Define scope Create work breakdown structure (WBS) Verify scope Control scope
Project Time Management	Define activities Sequence activities Estimate resources Estimate activity Develop schedule
Project Cost Management	Estimate costs Determine budget Control costs
Project Quality Management	Plan quality Perform quality assurance Perform quality control
Project Human Resource Management	Develop human resource plan Acquire project team Develop project team Manage project team
Project Communication Management	Identify stakeholders Plan communications Distribute information Manage stakeholder expectations Report performance
Project Risk Management	Plan risk management Identify risks Perform qualitative risk analysis Perform quantitative risk analysis Plan risk responses Monitor and control risks
Project Procurement Management	Plan procurements Conduct procurements Administer procurements Close procurements

Components of the PMBOK framework have been combined with the process based PRINCE2 methodology. This combination offers benefits of a holistic methodology (PMBOK) mixed with the strong process based PRINCE2 framework which was constructed to conform ISO9001 from its inception (9).

### 3.4 Overview of PRINCE2 Methodology

PRINCE2 is a management methodology for **PR**ojects with **IN** Controlled **E**nvironments. PRINCE2 is a prescriptive project management methodology, originating from the information technology (IT) field. This can be altered and adjusted to the needs of individual customers and then each project can have the process tailored to fit the specific project:

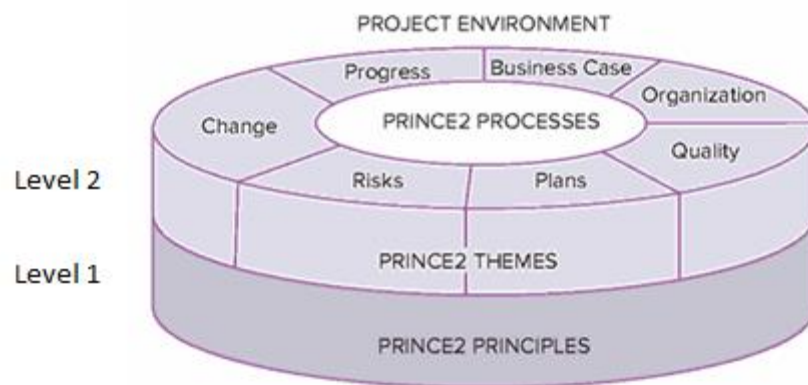


Figure 4: The structure of PRINCE2 (10).

The key components of the PRINCE2 project management methodology are outlined below in Table 3 with their inter-relationships highlighted in Figure 4 above.

Table 3 : PRINCE2 Overview (11)

<b>PRINCE2 Principles (Level 1)</b>  These are the concepts to which all components of PRINCE2 are guided by. These principles are achieved by the range of themes supported on level 2.	<ul style="list-style-type: none"> <li>- Continued business justification</li> <li>- Learn from experience</li> <li>- Define roles and responsibilities</li> <li>- Manage by stages</li> <li>- Manage by exception</li> <li>- Focus on products</li> <li>- Tailor to suit the project environment</li> </ul>
<b>PRINCE2 Themes (Level 2)</b>  The themes describe how PRINCE2 recommends carrying out various aspects of project management.	<ul style="list-style-type: none"> <li>- Business Case</li> <li>- Organisation</li> <li>- Quality</li> <li>- Plans</li> <li>- Risk</li> <li>- Change</li> <li>- Progress</li> </ul>
<b>PRINCE2 Processes</b>  7 processes cover the management of the work involved with the project from just before the project starts to the end of the project.	<ul style="list-style-type: none"> <li>- Starting up a project</li> <li>- Directing a project</li> <li>- Initiating a project</li> <li>- Controlling a stage</li> <li>- Managing product delivery</li> </ul>

	<ul style="list-style-type: none"> <li>- Managing a stage boundary</li> <li>- Closing a project</li> </ul>
<b>Project Environment</b>  This determines how to embed PRINCE2 into an organisation, and then for each individual project, PRINCE2 must be tailored to meet the individual project needs.	Embedding within a company: <ul style="list-style-type: none"> <li>- Process responsibilities</li> <li>- Scaling rules / guidance</li> <li>- Standards (templates, definitions)</li> <li>- Training and development</li> <li>- Integration with business processes</li> <li>- Tools</li> <li>- Process assurance</li> </ul> Tailoring for individual projects: <ul style="list-style-type: none"> <li>- Adapting themes</li> <li>- Incorporating specific terms</li> <li>- Revising product descriptions for the management products</li> <li>- Revising PRINCE2 role descriptions</li> <li>- Adjusting the process to match above</li> </ul>

### 3.5 Overview of Agile Project Management Methodology

Agile project management is an iterative method to fast-track projects typically in software development and engineering requiring flexibility and significant interaction from all participants in the project (12). Scrum is a form of Agile project management. Typical separation of the design, development and testing stages does not occur in Agile project management. It is usual to have the scope of the project still under development more than halfway through the project (13) (14).

Agile Scrum project management is:

- An iterative process (repeated every 2-4 weeks)
- Responsive to change in scope
- A team based approach (no project manager)
- Improves communication and cooperation
- Protects different teams from obstacles and interruptions
- A way to maximise productivity

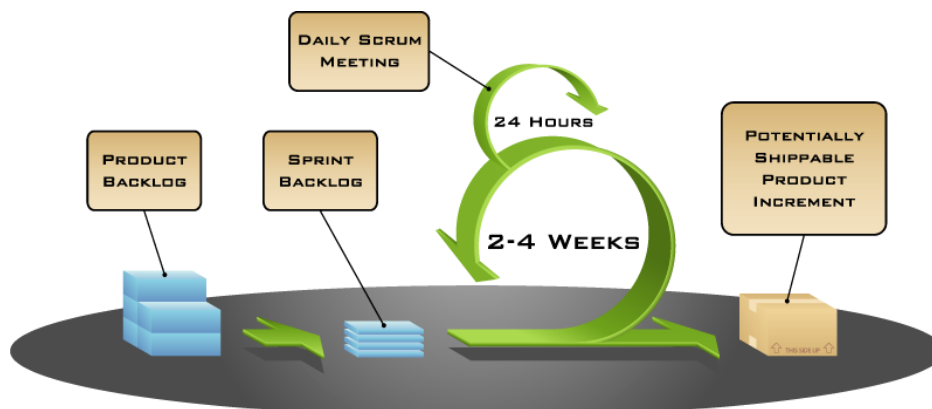


Figure 5: Agile Scrum cyclic methodology (15) – Further explained in Appendix B – An Agile Project Management Overview.

### 3.6 Comparison of Project Management Techniques

Table 4 was developed based on overviews of the project management methodologies combined with relevant literature. It is noted that Agile project management is suited for fast paced software projects, where PMBOK / PRINCE2 are more suited for projects where requirements can be more easily defined in the early stages of the project and where changes in requirements would be less fluid (16). Typically projects performed by Falcon Electrical have their scope clearly established early on in the project if the correct requirements analysis takes place. However, some fast moving automation projects require an Agile, iterative approach for their execution.

**Table 4: Comparison of project management methodologies / frameworks (17) (18).**

<b>Factor</b>	<b>PMBOK / PRINCE2</b>	<b>Agile Project Management</b>
<b>Structured focus</b>	Tools and processes	People
<b>Completion focus</b>	Paperwork and contractual documentation	Results and deliverables
<b>Leadership style</b>	Authoritarian	Participative
<b>Level of documentation</b>	Minimal to heavy depending on adoption	Minimal
<b>Trust</b>	Negotiation	Collaboration
<b>Customer interfacing</b>	Negotiation	Collaboration
<b>Project direction</b>	Minimal, perhaps only at project termination	Throughout project
<b>Project solution</b>	Follow the plan exactly	Respond to changes
<b>Delivery</b>	Often late delivery	Shorter delivery time
<b>Unused features</b>	Too much 'gold-plating'	Minimal
<b>Number of features</b>	Too many	What the clients' needs
<b>Acceptance</b>	Often a high rejection of deliverables	Minimal number of rejected deliverables
<b>Best practices and lessons learned</b>	Discovered from success	Discovered from success and failures

### 3.7 Analysis of Offerings and Conclusions

The strengths of the PMBOK, PRINCE2 and Agile project management methodologies are all relevant to certain facets of projects managed by Falcon Electrical. Aspects from these frameworks/methodologies will provide useful tools and methods to assist in increasing the project management abilities of staff at Falcon Electrical.

These tools should be used to provide assistance to project management, not replacement of sound project management (19). The prescriptive methodology of PRINCE2 can be modified to resemble frameworks provided by PMBOK and the recently developed Agile Project Management techniques in order to best suit the wide variety of projects that Falcon Electrical performs. These frameworks are well established and recognised worldwide, and with some modification will suit the projects Falcon Electrical undertakes.

Falcon Electrical performs projects with complex specifications and requirements; the business also performs simple projects with low levels of scoping. It is often up to Falcon Electrical to create the project scope. The sequential, document driven processes of PMBOK and PRINCE2 can work for the well-defined projects. These methods (when applied to software projects) can tempt people to overpromise software capabilities in contractually binding requirements specifications or quoting documents (20). This can occur before risk implications surrounding the requirements and outputs are fully understood. The code driven nature of Industrial Automation projects can lead to the addition of features, with little consideration given to the impacts these changes may have on other program features. A study of failure factors in 1027 IT projects in the United Kingdom (UK); scope management was cited to be the largest problem in 82% of the projects (21). Evidence suggests that Falcon Electrical will be able to clearly define projects using these methods, and will better meet the needs of the client (7). A summary of the strengths and weaknesses of each methodology is displayed below in Table 5.

**Table 5: Summary of strengths and weaknesses**

	<b>PMBOK</b>	<b>PRINCE2</b>	<b>Agile</b>
<b>Strengths</b>	<p>Well established framework.</p> <p>Well defined method for progressing projects – if followed completely it ensures no questions or problems are over looked.</p> <p>Recognised as by ISO as a way of implementing ISO10006 Quality Project Management.</p>	<p>Well established framework.</p> <p>Can be adapted to embed within the organisation.</p> <p>Can be scaled and adopted to match the size of projects.</p> <p>Accounts for change control and configuration management, meeting ISO9001 guidelines.</p> <p>Focuses on principals / lessons learned.</p>	<p>A frame work involving multiple iterations.</p> <p>Very responsive to changing client needs.</p> <p>Use of this method for software projects shows significant advantages over the prescriptive PMBOK and PRINCE2 methods.</p>
<b>Weaknesses</b>	<p>Heavy documentation.</p> <p>Needs adaption for software development projects.</p>	<p>Can present a large overhead.</p> <p>Must be modified significantly to allow for smaller projects.</p>	<p>Fast moving.</p> <p>Requires a motivated client.</p> <p>If the software is production critical, this method will often not suffice as the cost of production downtime is too high.</p>

In order for the project management implementation to succeed at Falcon Electrical, the following critical success factors were determined:

### **3.8 Critical Success Factors**

Changing processes, procedures and information flows requires many factors for these changes to be effective. The company culture is determined by the following critical success factors. Enterprise-based case studies and organisational research identifies these factors as 'must haves' for the implementation of a project management system (22) (23) (24):

1. Employee involvement - mobilise energy and commitment through joint identification of business problems and their solutions
2. Identify the leadership
3. Institutionalise success through formal policies, systems and structures
4. Focus on results, not on activities
5. Start change at the periphery, then let it spread to other units without pushing it from the top

The above critical success factors are essentially change management factors that need to be adhered to, however they do not mention whether changes should be continuous or discontinuous. A discontinuous change approach, where structural and strategic changes are deployed organisation wide over a short period of time, is still employed in multiple recent change initiatives (25). However, contemporary authors on the subject point towards adopting a continuous change management approach, where changes are made gradually and adjusted based on feedback and performance, as the benefits from discontinuous changes tend not to last (26) (27).

Adopting a continuous change management process will thus be more effective in generating increases in project management effectiveness. It is therefore recommended a continuous change management cycle is implemented to assist with the project management system (3).

A well-developed change management cycle associated with Quality Management Systems such as ISO9001 and Total Quality Management (TQM) is Deming's Wheel or the Plan-Do-Check-Act (PDCA) cycle (28). The PDCA cycle has four key stages that are repeated sequentially:

1. **Plan:** Establish goals, determine approach
2. **Do:** Implement approach
3. **Check:** Monitor implementation, analyse results
4. **Act:** Take corrective actions

A detailed overview of this is highlighted in [Appendix C – The Deming Cycle: Plan-Do-Check-Act](#). It is recommended this framework is used alongside the ISO9001 framework to ensure maximum

implementation effectiveness is gained. An overview of the ISO 9001 QMS is attached in [Appendix G –ISO9001 & its Critical Success Factors](#).

## 4 Employee Motivational Theory

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Employee involvement, combined with leadership strategies was identified in section 3 Critical Success Factors as key to the success of the project. Multiple theories on employee culture, motivation and leadership exist. Many of these theories have case studies which highlight real world applications. Key influences from these theories are highlighted in [Appendix H – An overview of Employee Psychology](#). Analysing and understanding how employees react to process changes and the underlying motivation that drives these reactions, it is beneficial and will aid in creating the culture to allow business processes to evolve (29).

### 4.1 Implications for Project Management System Development

If applied correctly the employee motivational theories explained in Appendix H – An overview of Employee Psychology will benefit Falcon Electrical's project management systems:

- **Maslow's Hierarchy of Needs:** Falcon Electrical should determine if it is providing for the needs of employees. By ensuring factors in lower levels of his hierarchy are met, employees will develop further. Creativity and problem solving skills gained from the higher levels of Maslow's Hierarchy enable increased productivity. This will provide the basis for the following theories to be implemented.
- **Double loop learning (Action Science):** The use of double loop learning will enable employees to understand the systems and processes in Falcon Electrical. This understanding will enable them to question and be involved in the creation of the systems and processes. This involvement in decision making will be encouraged by the following management style.
- **Theory Y management style:** This management style supports a participative approach which assists in developing and implementing a QMS system. It may be necessary for Falcon Electrical to use classical Theory X management style for some tasks and responsibilities that are predictable and repetitive. "Enterprises with highly predictable tasks perform better with organisations characterised by the highly formalised procedures and management hierarchies of the classical approach. With highly uncertain tasks that require more extensive problem solving, on the other hand, organisations that are less formalised and emphasise self-control and member participation in decision making are more effective" (43).
- **Vroom's Expectancy Theory:** Employees could be rewarded for performing projects or service work to an exceptional standard, above the expectations of both clients and Falcon Electrical.

- **Dual Factor Theory:** By ensuring the correct hygiene factors are in place at Falcon Electrical job dissatisfaction will decrease, see Figure 13: Herzberg Hygiene Motivation Theory. Motivating factors such as recognition, responsibility and opportunities for personal growth need to be placed within the Falcon QMS and Project Management System.

These employee motivational theories, combined with the following considerations will provide strong strategies for a successful project implementation.

## 5 Considerations

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The key social and ethical considerations for any systems within businesses include:



**Figure 6: Key ethical considerations for any business system (44).**

In general, businesses must fulfil economic responsibility (profitability) and legal responsibilities (obey the law) to continue to operate. These two considerations should be combined with ethical responsibilities as often, the image of trust and integrity is crucial to organisations' profitability (51) (52). The above responsibilities were the key drivers for developing the project management system at Falcon Electrical.

## 6 Project Implementation and Results

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### 6.1 Existing State

To develop Falcon Electrical's Project Management System, the existing position of the company must be understood. The following sections highlight the existing state of project management procedures, project documentation, staff views on processes and customer feedback on project management procedures at Falcon Electrical.



### **6.1.1 Current Project Management System**

A variation, across the departments at Falcon Electrical, in the project management systems has developed over time due to the diverse nature of the work. Large projects lack a formal structure to store and communicate data to all involved at Falcon Electrical and project stakeholders.

Smaller projects performed by Falcon Electrical do not have any formal data associated with them. Simply a bill is produced for servicing work, with all electrical engineering and requirements held in the service electrician's head. For jobs with increased complexity, the use of information systems is inconsistent, leading to lost information, duplicates of information and general disorganisation. Rectifying this situation is key to the success of implementing a QMS and a Project Management System.

### **6.1.2 Information Systems**

#### **SimPro**

Part of the project involved significant work in, and engineering processes around SimPro. This is a cloud based system with features such as:

- Client information manager (location, contacts etc.)
- Project leads
- Project quotes
- Current projects
- Completed projects
- Resource management:
  - Employee time scheduling
  - Materials ordering
  - Stock management
- Billing of project and service work

As with any package software, however, there are drawbacks and issues with the operation of the software. Based on case studies (41), it is strongly recommended that Falcon Electrical re-engineer business processes around the software rather than attempt to modify the software.

#### **File Store / Server Setup**

The current server setup is partitioned as follows:

- Customers
- Quotes
- Projects
- Administration

Employees have access to all drives, excluding administration. For a single project, information could be found across multiple drives and folders, leading to a lack of clarity as to where information is, and should be, stored.

### 6.1.3 Employee Views

Staff feedback, summarised in [Appendix E – Employee views on Project Management](#), highlighted the following issues that are concerning some employees:

**Table 6: Employee opinions on causes of project disruptions.**

Issue	Effect on Project
Staff pulled from jobs to work on other jobs	Loss of work flow and having to explain scope of work multiple times to different employees
Service work disruptions	Reduces project progress, can lead to unsatisfied customers
Pricing based on skilled labour, not all employees have a high skill levels	Reduced accuracy in quoted jobs – can cause profitability issues
Organisation, who is leading a project & who is responsible for dealing with the client	Causes communication issues or confusion. Can lead to difficulties in ensuring all information is organised for a project.
Lack of clarity of scope, unsure of true client requirements	Reduced accuracy of project scoping, leading to project scope creep through project duration, time delays and cost increases
Poor design of electrical work	Unsatisfied clients or changes in installation leading to cost overruns
Variation Order procedures	Variations performed without explicit work order instructions. Leads to challenges in billing for all work performed
Work completed after final claim – often not billable. Client sees changing scope as warranty claims	Reduces profitability on projects or jobs
Inadequate understanding and inconsistent use of SimPro	Lowers process efficiencies if work is not performed using all the information

### 6.1.4 Feedback from Customers

Customer feedback provided an insight into factors which generated successful projects, and projects which did not provide the client's desired outcomes. Based on the feedback summarised in [Appendix D – Customer feedback on Project Management](#) the following conclusions can be made:

**Table 7: Client views on how projects succeed and fail.**

Successful Projects	Failed or disrupted Projects
Clear project scope based on specifications and drawings will generally lead to higher levels client satisfaction	Lack of ownership of the job
A good understanding of project by clients enables clear scoping work to be performed.	No management of the job
Regular updates on project progress should be provided to clients	Labour placed onsite without correct management (materials, work packages,

	knowledge of project etc.)
Narrative Functional Description and Graphical Functional Description have worked well for recent projects where client involvement has been high.	Variation process not followed correctly
	Scoping and requirements not understood correctly or recorded
	Lack of project closure or formal documentation associated with project

### 6.1.5 Conclusion on existing state

The management of information presents the biggest obstacle in regards to management of projects. Alongside this, steps towards correcting the following issues must take place:

- Lack of ownership of projects
- Undefined project scopes and project boundaries
- Unclear responsibilities involving:
  - Ordering of materials
  - Scheduling of time
  - Management of variations

## 6.2 Project Aims

To develop and execute the project plan, the following categories have been separated into three sections. The associated project results are situated within these sections.

1. Management of Project Information
2. Management of Service Information
3. Project Management Systems / Guides and Project Management Documentation

The development of documents, document control, procedures and lists relating to project management and servicing information has been seen as an important output of the project.

### 6.3 Project Output 1: Management of Project Information

Managing information relating to projects at Falcon Electrical is important for two reasons:

1. Working towards ISO accreditation requires that change tracking and release procedures are implemented and followed (45).
2. The ability to view and control changes in documentation and information is important to the management of a project.

The existing software solution, SimPro, allows for complete tracking and change control of who has viewed, modified or added to all quotes, project and jobs. However, this software does not manage the technical / engineering information relating to a project. By creating a standard format for the

project information to be stored on the file store it will become more accessible. Information for a project of medium-large size projects can be categorised by the following:

1. Requirements and Scoping
2. Drawings and Programs
3. Proposal and Quote
4. Signed Contracts
5. Purchase Orders & Supplier Quotations
6. Progress Claims and Variations
7. Closeout Documentation
8. Photos

The structure provides a solution to the lack of project closeout documents which had been identified as an issue by some customers. An overview of the information system is displayed in Figure 7 on page 19.

It is necessary to have both electronic and paper copies of much of this information as employees do not have access to server information when onsite. The use of a physical folder for both the project manager and lead electricians (onsite) which matches the layout above will help ensure folder information storage remains consistent between projects, employees and divisions of Falcon Electrical.

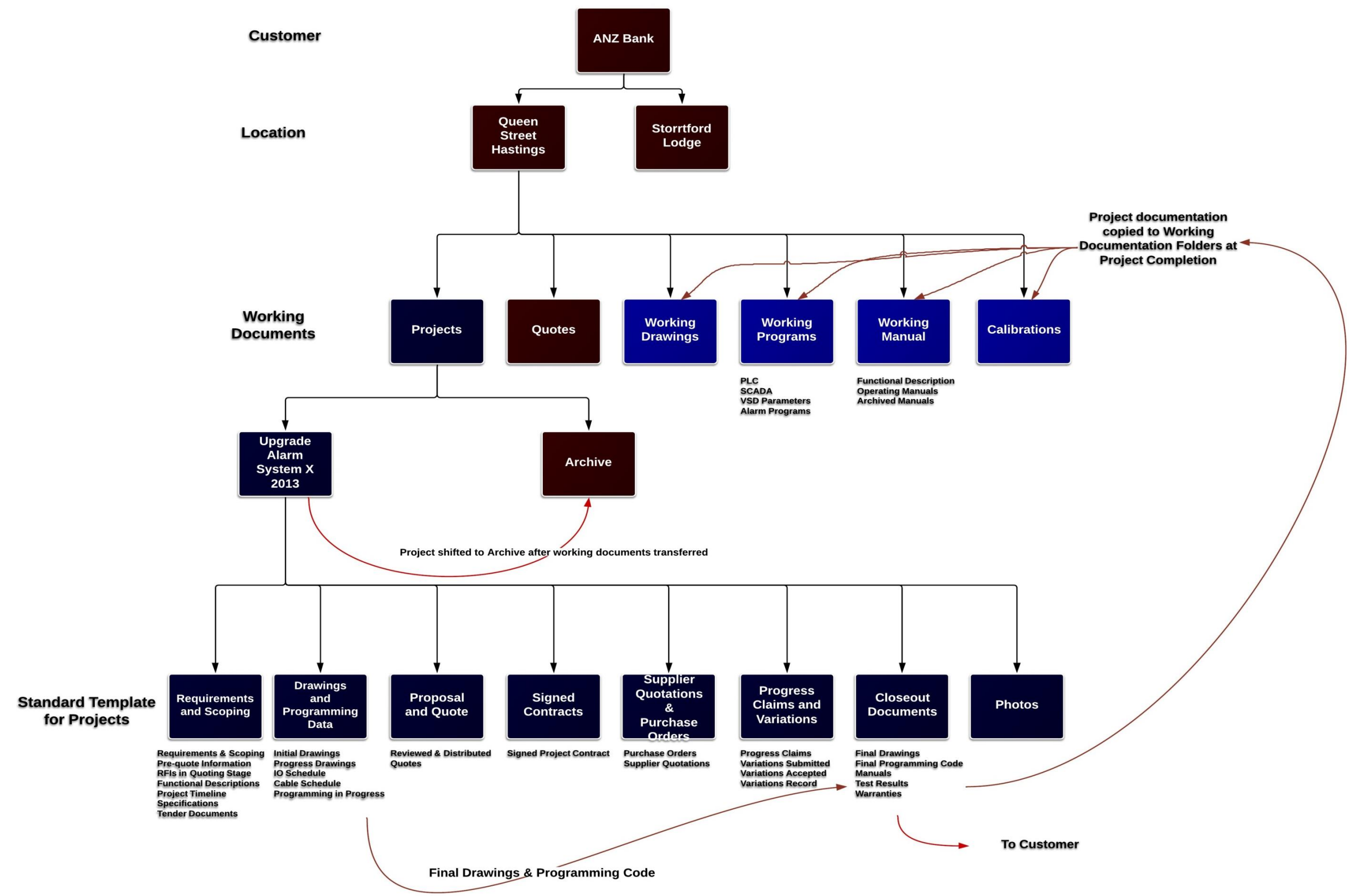


Figure 7: Overview of Project and Service Information System

## **6.4 Project Output 2: Management of Service Information**

The difference in ongoing service work and project based work requires a distinction between storage and modification practices. Once a project has been completed, the information relating to servicing the customer assets (and the specific area of their site if applicable) is extracted from the formal structure of the project. After reviewing the information requirements across the divisions of Falcon Electrical, it was found the information required for servicing customers could be classified into 4 sections.

- Working Programs
- Working Drawings
- Working Manuals
- Calibrations

This “Working” information is also guided by document management and revision control highlighted in [Appendix F – Document List](#).

## **6.5 Project Output 3: Project Management Systems / Guides**

The need for formal processes and related documentation to occur at certain stages of projects was defined as an important output of the project. There are key stages throughout a project where responsibilities must be defined, project information must be stored or distributed and where information on both SimPro and the file store need to be modified or shifted. The processes identified as essential to the project management operations include:

- Customer set-up
- Quote set-up
- Quoting process
- Requirements management
- Job specific supplier quotations
- Define project responsibilities
- Project handover process
- Ordering materials
- Drawings management
- Programming management
- Variation processes
- Testing & commissioning sheets
- Compliance requirements
- Project closeout

An overview of the documents produced is supplied in [Appendix F – Document List](#).

A further key part of the project management system is the management of requirements and variations. As most of the work is quoted for a fixed price, gaining all requirements at the project initiation stage is important in order to successfully create:

- Accurate quoting
- Scheduling and resource requirements
- Technical specifications

## **6.6 Other Project Outputs**

These outputs are unintentional by products resulting from the project performed for Falcon Electrical:

### **Data Organisation:**

The existing data structure at Falcon Electrical needed to be modified significantly to enable the project management processes to be developed and work effectively. Modification of the data involved:

- Re-organisation of programming data, checking for most current version and archiving past versions
- Separating working drawings, programs and manuals from past projects
- Re-organising drawings and formatting the most recent version into an appropriate file type (making it more accessible)

In some cases knowledge of large customer sites was limited, which meant the organisation of most, but not all customer specific information. This has led to an improvement in the organisation of information and the ability to locate relevant data. It has not, however, improved the organisation of past projects at Falcon Electrical with some information relating to past projects unavailable.

### **SolarPlus Software:**

Trialling of the Solar Plus software for generation performance data, installation requirements and user manuals of solar panel installations was performed. The aim of this system is to generate fast, professional and accurate electrical performance projections of solar panel installations.

Multiple installation configurations can easily and quickly be generated with minimal input by the user. A comparison of the configurations is then generated, along with the predicted output. Based on this information the payback period for the solar installation can be predicted. In addition, the required user manuals and maintenance requirements are generated as a form of a project closeout document.

## ***6.7 Conclusions for Project Management in Electrical Contracting & Servicing Businesses***

### **Scoping and requirements analysis:**

Although some of the projects performed by Falcon Electrical are “specify and tender” contracts, the ability to manage requirements in software projects is a critical success factor to ensure the projects are completed on time, budget and to expected quality.

### **Customer Service:**

The ability to communicate information to customers clearly, succinctly, and in a customer friendly manner should not be underestimated. Customer feedback suggests the ability to respond quickly to customer requests is seen as crucial to maintaining and improving customer relationships (46). Strong relationships are crucial to success in any business.

### **Company Culture:**

The company culture was highlighted as a key success factor in [3.8](#) Critical Success Factors alongside the need to manage change processes as a continuous, rather than discontinuous way. Falcon Electrical has a personal, interactive company culture where employees assist each other across divisions; it also has a hierarchical structure for some aspects of the companies operation. Future employees should be interviewed and considered not only technical ability, but the following aspects as well (45):

- A drive for quality
- Personable
- Communication
- Organisation
- Willing to adapt and motivated by improvement of systems
- Willing to assist others
- Willing to bring attention to issues

A culture where employees strive for excellence in service and quality must be developed within the Company. This culture will help to facilitate the implementation of project management systems and other future changes at Falcon Electrical. Maintaining clear communication and fostering a positive company culture must be a focus of management at Falcon Electrical in order for this to be developed. This will assist the Company as it continues to develop an ISO9001 accredited QMS.

### **Assigning Responsibilities & Project Ownership**

The often complex nature of some projects performed at Falcon Electrical (small and large projects both involving upwards of 4-8 employees) has led to communication breakdowns, loss of information and other impediments on project progression. Assuming Theory Y style management, the



assignment of responsibility and project ownership will clarify the tasks to be performed by the individual employees.

## 7 Recommendations

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### 7.1 QMS implementation

In order for a successful implementation of a QMS at Falcon Electrical, the following tasks must be performed:

- **Continual Improvement:** A continual improvement approach needs to be taken with both existing and new procedures introduced at Falcon Electrical. This drive for excellence will continue to provide benefits to the company. This could be achieved by continued use of the Falcon Improvement Program (an existing company improvement process) and project audits.
- **Employee Involvement:** Gaining buy-in from employees is crucial. Debbie Phillips-Donaldson states “Most quality professionals and experts would agree the top level buy-in is most important” (48). Although the tasks and requirements of the QMS should be led by management, without the engagement of employees, integration is likely to fail.
- **Ownership and Direction of QMS:** An owner of the QMS should be identified, with a committee of management overseeing its direction and ensuring it is providing value (49) to Falcon Electrical.
- **Auditing:** The process of creating documents and processes should be checked to ensure the ISO9001 system is being followed. Checks with regards to the use of systems should be in place, with a method for diagnosing faults and difficulties.
- **Resourcing:** Sufficient time should be given to ensure the system can be integrated properly and correct training given to employees (50). Without this, resistance to altering systems and methods of working may be encountered. Some systems may require more resources (time, technology etc.) therefore an allowance should be made for this.

Additional factors are highlighted in Appendix G –ISO9001, which, combined with the above will produce a successful ISO9001 implementation. Common impediments to progress are also detailed in this Appendix G.

### 7.2 Strategy; Market Trends and Impacts

An in depth analysis of the Electrical Contracting and Servicing Business can be found in

Appendix I – Electrical Contracting Strategic Analysis. Lessons learned from this analysis, combined with information from the implementation of the project management system highlights the following Critical Success Factors (CSFs) and Key Result Areas (KRAs):

- Ensure quality projects are delivered to the clients: *KRA - improved customer feedback & increased levels of repeat work.*
- Professionalism should be maintained throughout the company: *KRA - improved brand awareness & employee qualification levels.*
- Company Direction and Guidance (leadership): *KRA - improved change management.*

## 8 Summary of Personal Reflections

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### What was expected to happen?

- The purpose of the project was to investigate the existing project management systems at Falcon Electrical.
- Recommend a system for managing projects and enabling up skilling of employees.
- Provide required materials and systems to improve the project management.
- To be performed over a duration of 700 hours completed from October 7<sup>th</sup> 2013 to January 31<sup>st</sup> 2014.

### What actually occurred?

- Familiarisation with the scope of work performed by Falcon Electrical.
- Systems investigated and reviewed:
  - Investigated weaknesses and identified areas of improvement.
  - Looked into strengths and areas to guard.
- Recommended a system to manage information across all projects and divisions of Falcon Electrical.
- Gained significant knowledge of commercial and industrial electrical works including:
  - PLCs, SCADA Systems and industrial automation integration.
  - Security systems installations and maintenance.
  - Design-build contracts and spec and tender contracts.
  - The wide range of information associated with projects.
- Assisted with organisation of digital information relating to many of Falcon Electrical's customers and projects.

### What went well & why?

- Assisted with the organisation and management of commercial installation projects and industrial automation projects. Enabled project managers to create clear work instructions and plans for onsite employees.

- An understanding of systems and software programmes developed and improved as the project progressed. This enabled me to assist with bid preparation and planning of tenders compiled by Falcon Electrical.
- Training and buy-in with some employees produced good results. Projects were operated well and ran smoothly. The appropriate project closeout documents were created and delivered to the client. This was achieved with organised and driven managers who are keen to see thorough projects completed by Falcon Electrical.
- Continued use of requirements management tools and the assignment of project responsibilities will see improved:
  - Communication
  - Cost control
  - Project quality

### **What can be improved and how?**

The below items highlight areas of difficulty encountered through the project and where Falcon Electrical can improve its future performances.

**Table 8: Areas for improvement & how they can be improved.**

<b>Area for improvement:</b>	<b>How this can be achieved:</b>
Increase buy-in from all involved with QMS or project management system.	Improving involvement in the Falcon Improvement Process. Ensuring all employees are aware of the drive towards ISO9001 accreditation & the benefits associated with this accreditation.
Management of project related information.	Ensure all employees managing projects or quotes are aware of how information should be organised.
Management of working documentation.	This is an ongoing task relating to the organisation of customers information. As information relating to the service information is accessed, it may need to be organised to fit the new system.

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## Appendix A - Process model of PRINCE2

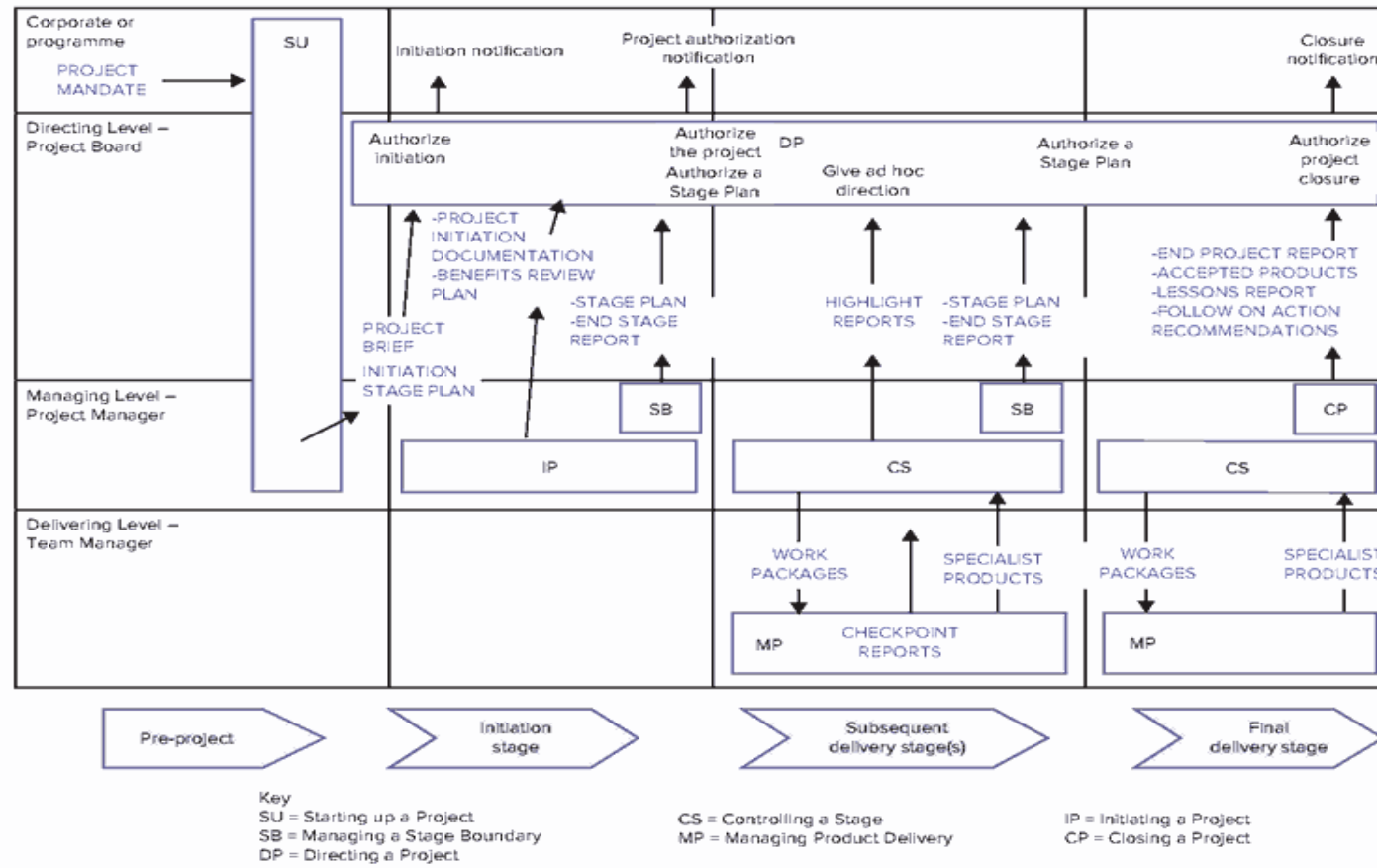


Figure 8: PRINCE2 Project Process Overview (8)



## Appendix B – An Agile Project Management Overview

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Scrum was first developed in Japan 1986 in opposition to the traditional waterfall model to create a “flexible, product development strategy” in the photocopier, printer and automotive industries. In 1995 “Scrum methodology” was presented at the Business Object Design and Implementation Workshop at a software development conference. Since then it has been used by many software development companies such as Yahoo, Microsoft, Siemens etc. (46).

### Who is involved in Scrum Projects and their responsibilities?

- Client
  - o Develop Product Backlog of what they want produced. Add and remove components as the project progresses. Must remain in close contact with customers/end users.
- Scrum Master
  - o Filled by a team member who reports to company management. Is responsible for enforcing scrum practices and removing impediments to progress.
- Scrum Team
  - o Responsible for completing / reporting of work discussed in daily scrum meetings. Must look forward to see any possible hindrances to progress. Typically a group of 3-10 members.

### How Scrum Project Management Works

1. The Client, Scrum Master and Scrum Team meet to create a product backlog at the beginning of a project. This backlog is then prioritised in order of importance to completion of the project.
2. A product function will define each sprint which lasts 2-4 weeks. There will be no change in this function (or scope) over the sprint period.
3. Sprint planning occurs. A sprint backlog is created. These items need to be completed within the 2-4 week period.
4. Daily 15 minute Scrum meetings are held to ensure the sprint deadline will be met. Scrum team, Scrum Master and clients are involved in these meetings.
5. Once the sprint has been completed, the client is involved with a sprint retrospective.
6. Steps 2-5 are repeated until the project is completed. Note that the client will alter the scope through the duration of the project.

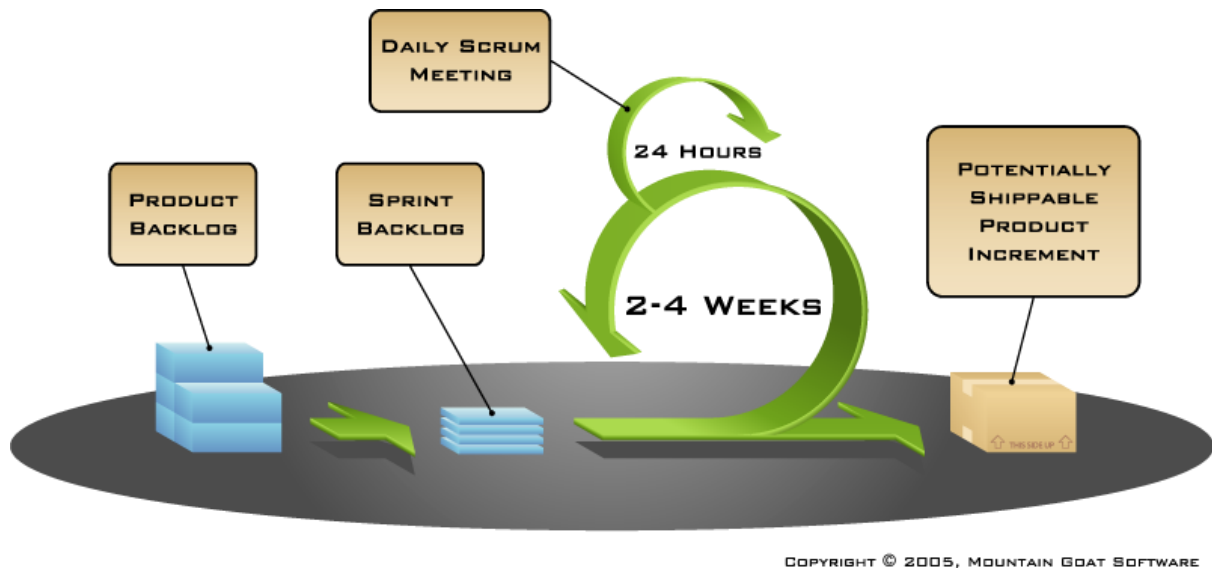


Figure 9: Agile / Scrum Project Management Overview

## Scrum Components

### ***Sprint Planning Meeting***

All participants in the project will decide what product function will be completed in the next sprint. This is led by the Client, with input from the Scrum Team.

The Client will leave the meeting and the sprint backlog will be created by the Scrum Team. A duration estimate for each item on the sprint backlog is given to ensure that the sprint deadline can be met. This sprint backlog is updated by the Scrum Team at the daily Scrum Meetings

### **Scrum Meetings**

This is the crucial component of this project management method. The meeting has a few rules which must be enforced by the Scrum Master:

- Time limited to 15 minutes daily – usually early morning
- Stand up – informal meeting
- Team members must answer:
  - o What was completed yesterday?
  - o What will you do today?
  - o Is anything in your way?
- The meeting avoids unnecessary meetings during the day

### ***Sprint Review***

This is where the function developed over the past 2-4 weeks is presented to all involved with the project. A maximum of 2 hours of prep time is allowed with no slide shows allowed to be used. Each Scrum Team Member describes what they achieved over the sprint through an informal meeting.

## Appendix C – The Deming Cycle: Plan-Do-Check-Act

The Deming Wheel or PDCA Cycle is a simple tool that should be used when implementing changes within an organisation to work towards a quality management system. This methodology is also appropriate for use in Agile Project Management which has gained popularity over the past decade.

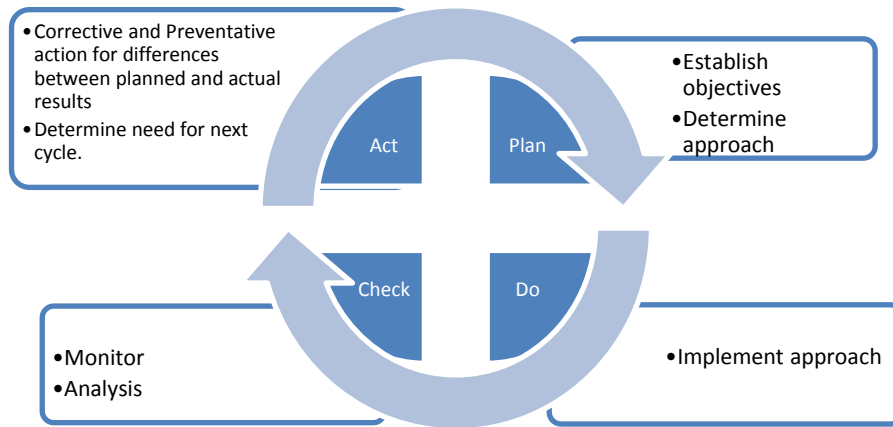


Figure 10: Plan-Do-Check-Act cycle.

The PDCA offers the following advantages when implementing developing a quality management system. The cycle should be continuously repeated to maximise benefits (47).

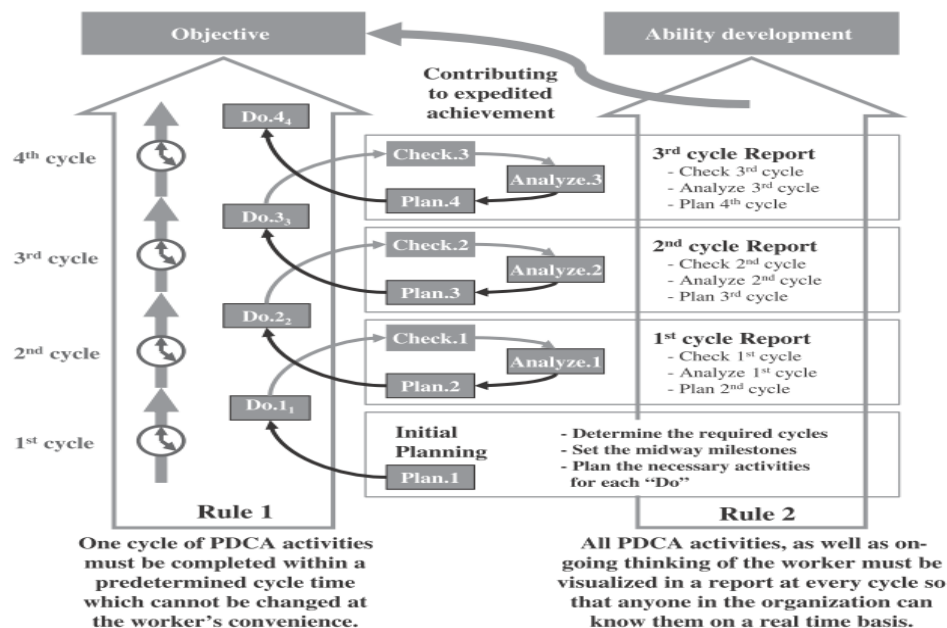


Figure 11: PDCA cycle and its continual implementation (47).

## Appendix D – Customer feedback on Project Management

The following information was garnered (in note form) from surveying clients of Falcon Electrical. A summary of responses is shown along with *conclusions drawn in italics*.

**How was the project managed as it turned from an idea to a proposal?**

Customer 1	Very poorly – wrong person on the job No management of the job 100K Variations Bills for project 6 months after completion
Customer 2	Customer sees Falcon as their electrician. Overseas firms could provide upgrade, Falcon said they could perform task. Site meetings then generate proposal Initial project lead not suited to job or managing job Scope of work not clear No requirements recorded 3 stages over 3 seasons
Customer 3	A need to migrate controls, dealt with Ctech last time, unsatisfied with performance from them – significant improvement in using Falcon Electrical. No project brief or scope generated NFD generated following meetings with Falcon, Operators and site sparky – these worked well
Customer 4	Data Cabling for digital projection and network No 35mm film produced anymore from 2014 – Napier was a test site for Reading Cinemas refit of its national chain with digital projectors.

*Some project scoping and associated proposals have been performed poorly in the past. A lack of appropriate documentation leads to projects not producing desired result and issues if projects managers change during the duration of a project. However significant improvement has occurred through the latest Automation upgrade. This significant improvement has occurred with extra project management effort placed by the customer and a collaborative approach to creating the system functional description.*

*Although the GFD and NFD were done well, the project scoping was still not performed at the start of the project.*

**Did the project produce the outcomes you expected?**

Customer 1	No COC not signed DOC not signed
Customer 2	90% the way there Not all original functionality available now Still missing some items
Customer 3	Yes: Feedback from isolators Displayed on HMI screens
Customer 4	Yes – Drawings and requirements put together by a design engineer based out of Auckland CAT6A cabling not available in NZ so had to request to engineer a different cable to be installed.

*Project outcomes are generally met if the project has had correct documentation or significant buy in from customer (and the customer has been supervising the projects progress and ensuring project is progressing).*

**Was the project time critical?**

Customer 1	No
Customer 2	Yes as project affected production
Customer 3	In parts – not strictly adhered to, mostly because of the Wunderwear system changeover, removed Falcons ability to program information.
Customer 4	Yes.

**Was the project delivered on time?**

Customer 1	No – Used as a fall back job. Labour dumped onsite without management or control.
Customer 2	No – a small amount of disruption to production occurred.
Customer 3	Yes if considering the disruption time from software upgrade. Project still in completion mode – should be completed 15 <sup>th</sup> November 2013.
Customer 4	Yes 3 <sup>rd</sup> August initiation of project – Completed 2 <sup>nd</sup> of September, very quick turnaround.

**Did the project proposal clearly identify the scope of the project?**

Customer 1	No – Project was scoped very poorly and proposals did not include all items necessary for project completion
Customer 2	No correct project scoping Project was essentially to copy existing system; some parts were missed from this upgrade. A few improvements were included in the project that were not executed. Still missing some items.
Customer 3	Quoted each change separately.
Customer 4	Yes – Well scoped and priced accurately as the project was based on a set of engineered drawings.

**How were changes or variations managed through the project?**

Customer 1	Falcon presented variations after the project had been completed. Variations not controlled and completed without approval. Billing system not clear with bills arriving 6 months after the job.
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Customer 2	Large amounts of changes through the project. Initial project lead was working part time (personal issues etc.). Changes were done either as service jobs (if urgent and required) or quoted and approved. New managers involvement significantly improved the projects progress rate and performance.
Customer 3	Changes explained the need and reason for the change. All variations were priced.
Customer 4	Onsite – Variations were required. Technicians sought approval from Nicole before performing the Variations. Most of the variations were quoted which kept the project budget clear.

**Did the final project documentation provided to you contain all the information you require?**

Customer 1	Non-existent documentation. No standard electrical documents.
Customer 2	Haven't seen project documentation – They are still working on it.
Customer 3	Yes – As built drawings, GFD, P&ID, Electrical Drawings.
Customer 4	Yep a complete set of drawings from the engineer were accompanied by completed test sheets and other documentation.

**Were the documents you received with your project up to standard?**

Customer 1	Not applicable as no documentation provided.
Customer 2	Documentation not complete.
Customer 3	Not Applicable as project is on-going.
Customer 4	Yes.

**Was there a clear line of communication between you and Flacon Electrical Limited?**

Customer 1	A lot of confusion. Billing of variations which cost more than the project. Falcon appeared to run job as a service job and charge based on the work they performed rather than stick to the fixed price they offered.
Customer 2	Yep – no issues.
Customer 3	Yes – Project Progress meetings kept client and Falcon Electrical informed of the status of the project.
Customer 4	Yes – communication was very good.

**Was there a single point of contact?**

Customer 1	No, confusion with different labour onsite and no management of project.
Customer 2	Single point of contact, project communication much improved when new manager was managing the project.
Customer 3	No – both programmers were points of contact for the project.
Customer 4	Yes – there was a great single point of contact.

**What improvements could you recommend to improve the management of future projects at Falcon Electrical?**

Customer 1	Quote a price with the correct scope of work. Seek agreement from customer before any extras happen. When the job is finished, keep track of and explain why the extras were not included in the original quote. Bill through-out project; provide a project retainer which cannot be released until project completion and sign-off has occurred. Project contact was not onsite regularly enough Project progress was not reported to client correctly
Customer 2	More scoping and supervision of project would be beneficial Better (or correct) staff (e.g. someone who has significant site knowledge)
Customer 3	A push for a proper scope and project structure early in the project. This project was somewhat driven by client's systems, however not all clients will have these systems (such as regular progress meetings with minutes taken), to drive projects progress. The client made an additional effort to clarify their requirements in this project, which has led to a far more successful outcome if they had not pushed this from their end.
Customer 4	No glaring issues and project ran very smoothly considering the tight schedule. 1 Connector was broken (possibly by other contractor) which caused a drop in connection speeds. Falcon was onsite immediately to address this issue.

**Are you satisfied with the support provided by Falcon Electrical Limited for the recent project?**

Customer 1	No
Customer 2	More than satisfied
Customer 3	Good support during commissioning process Still supporting the commissioning process and finishing the punch list for the job.

Customer 4	Good – Very happy with project completion. Flacon used the other trunking where possible and cleaned up old wiring. The change of cable from CAT6A to Crone went smoothly with the approval of the engineer.
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## Appendix E – Employee views on Project Management

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The following survey on project management was performed, with the associated summarised results displayed below:

### How is a typical project (20k plus) run?

#### *Automation*

- Spec and Tender
  - o Quoting dept. base price of schedule.
  - o Instrumentation is assisted by the Automation Dept.
  - o Handover to PM if job is awarded
- Design-Build
  - o Client has an issue
  - o Options – design and price solution
  - o Sell solution (formalise solution) with a project scope
  - o Design build then install and commission
  - o Follow up and support

#### *SFD*

- Meet client onsite and receive information required for pricing
- Create a quote
  - o SimPro
  - o Structure sections for pricing
  - o Check drawings and specs
  - o Staging / time frames
- Submit quote
  - o Revision control
  - o Lost quotes archived once per month
- Convert quote
  - o Job sheet white and green
  - o Suppliers quotes
  - o Description with quantities
  - o Drawings
- Prepare for handover
  - o Longer jobs will sit down with project lead and discuss work, time and duration of job
  - o Pre-ordering for project handover
- Staff start on job
  - o 15-20 smaller project operating at once
  - o Check equipment, labour, progress billings
- Creation of Variations
  - o Quoted and a notice to contractors created
- All VOs are made before final claim is billed
- Post-mortem
  - o Any final labour put onto job after closing of job
  - o Review the good and the bad of jobs

#### *Switchboards*

- Talk to client and get correct info
- Prepare quote
- Submit tender
- If awarded, meet with client:
  - o Ensure it is correct
  - o Changes and discuss any variations
- Job goes to floor:

- Order and monitor parts
  - Monitor construction progress
  - Job conclusion – allow time for test cert, DOC, COC manual, docs and pamphlets.
- Factory Testing
  - Point to point
  - Directive test
  - Marked torque bolts
- Plan detail
  - Planned
  - Test Alterations
- Billing
  - 50% deposit
  - Progress to 90% delivery
  - Delivery including full price and variations
- Official format for the running of jobs:
  - Information gathering
  - Generate quote
  - Handover – job created and started
  - Monthly claims
    - Reveal equipment location
    - Reveal hours spent on projects
    - Extra items charged to project
  - Final Progress claims

#### **What are common sources of disruption of projects?**

- Pulling staff off job
- Service work disruptions
- Labour not skilled enough or pricing for different labour
- Organisation
- Hours not assigned to correct cost centre as people move between jobs
- Switchboards off the floor late – clients input required for engineering.
- Design-build quotes – customers sharing FEL Designs and information to competitors. Lots of free engineering given to client.
- 2 projects interfering with each other.

#### **What are typical sources of frustration for clients?**

- Timeline – Electricians typically first on, last off
- Delivery timeframe
- Poor engineering design of switchboards
  - Poor design
  - Changes
- Want to compromise standards
- Clarity of scope
  - Requirements not known
  - Clients unsure of their requirements
  - VO procedures, value limits on VOs
- Variations
- Lack of a clear path of communications
- Lack of understanding of the electrical scope of work
- Work carried out after final claims – often not chargeable
- Warranty Issues
- Less attention to detail

#### **Who manages the clients' requirements and scope of the projects?**

- 1 person manages requirements for automation projects – not always fully documented.

- Work around timeframes
- Falcon Electrical has high levels of knowledge for multiple clients and allows value engineering to be performed on their systems and projects
- Initially variations are managed through the builder as Falcon Electrical is usually contracted to them. The builder received orders from the project owner.

**How are changes made to the requirements of a project managed during the project?**

- Variation or Notice To Tenderer (NTT)
- Cost and then approved.

**Communication of information is important, so all involved with a project can be productive.**

**Are you always informed on your specific tasks and scope of your work?**

- Job not quoted correctly – blurred scope of work
- Clients not completely aware of their requirements – this can cause scope issues.
- Someone quotes programming – actual programming more difficult than expected.
- Upfront engineering – level required to accurate quote.
- Quoting:
  - Quoting and handover to project lead
  - Some staging input
  - Once handover complete very little input to how a project is run

**SimPro is used to manage projects from conception to completion. What are the difficulties you face within this program?**

- Switchboards
  - It is difficult to prepare a quote on SimPro for a complex switch board – much faster on Microsoft Excel.
  - Time not always assigned to correct cost centre – this is improving with the job cards.
- Quoting
  - Variations in Driving SimPro – people have different methods of operating the program.
  - Using partial fixes to get an end result – lack of training.
  - An inability to monitor projects – salesperson specific monitoring.

**Do you think the closure of a project (and the associated warranties, drawings and documents) can be managed better?**

- Should be done – not always handled correctly
- Testing documents
- User Manual
- Switchboards
  - Fact test sheet
  - Verification is type tested unit or partially type tested unit
- No formal way of closing a project (or understanding)
- Poor understanding of SimPro

**Additional comments on the project management systems in place at Falcon Electrical?**

- Have been to management course
- Still communication issues:
- Should be sharing all (non-confidential) information
- Project meetings are very beneficial
- A need for formal systems of managing cable lengths installed and recording any variations
- Use cable schedules to record pulled in lengths.

- Provide notice to contractors about the changing cable lengths
- If variations are not approved, the onsite work can be stopped.

## Appendix F – Document List

**Table 9: An overview of documents and processes developed.**

Document	Description
Project Document Storage	Provides an overview of how project documents should be stored
Project Folder Cover	A standard cover folder for all Falcon Projects
Project Folder Contents Page	A description of what should be stored within physical project folders
Site Folder Contents Page	A description of what should be given to lead electricians for their onsite work
Requests for Information	A form to use for RFI's in projects
Narrative Functional Description	A formatted document to be used for narrative functional descriptions of industrial automation systems
Project Handover	The requirements of a project handover. Assigns project responsibilities and ensures all involved are aware of their requirements in the job.
Notice to Principal	A form to be used for notice to principal
Project Documentation Checklist	A checklist of the handover documents to be given to clients at the completion of projects
Falcon Microsoft Project Template	A template to be used for creating schedules and time frames for projects
Cable Schedule and IO Schedule	A document which encompasses all technical information typically involved with industrial automation projects and commercial projects.
SFD Cable Schedule	A document which lays out a standard form to use in SFD projects for IO lists.
Claim Submittal Form	A NZS 3910:2003 and 3915:2005 construction installation procedures.
Project Punch List	A document used to classify and prioritise the remaining tasks to be completed nearing the closure of a job
Context Free Questions	A form used to clarify clients requirements & project scoping - useful for situations where the client is unsure or uninformed of his true requirements
Agile fixed price projects 1	An explanation of how requirements in software projects can be run, with scope control and change requests / exchanges.
Agile Fixed price projects 2	An explanation of how requirements in software projects can be run, with scope control and change requests / exchanges.
SimPro Quote Setup	Guidelines to setup quotes in the SimPro Software
Quote Folder Setup	Management of information for the quoting process
Customer Folder Setup	Directions on the creation of customer folders in the customers drive
Requirements Management	A document used for stakeholder requirements for complex automation projects
Quoting in SimPro	The structure and process for creating quote in SimPro
Preparing a Job Schedule	An instruction on using Microsoft Project to correlate to information in SimPro to schedule timelines for projects
Project Handover Process	An overview of the information that typically needs to be communicated to those involved with managing a project and those involved with onsite works. Highlights the assignment of responsibilities involved with managing the project.
Falcon Project Folder	Guidelines for organising information involved within the range of projects performed by Falcon Electrical

Customer Information Overview	Folder	Provides guidance on the separation of project based work and information related to the ongoing servicing of customers (the working documents)
Falcon Site Setup	Folder	Guidance on information needed onsite for lead electricians to effectively work onsite
Ordering Materials		Provides an overview of the materials ordering process in SimPro
Variations Process		Explains the need for the management of variations in spec and tender contracts, and provides guidance on the management of variations in complex software projects.
Modifying Drawings	Eplan	Provides a system for storing EPLAN Drawings and saving them in a format suitable for use on all Virtual Machines
Project Flow	Information	Provides an overview of how information should be managed from the quoting process through to project closeout
Project Process	Closeout	Details the key tasks involved with a successful project closeout.
Falcon Folder	Closeout	Provides a standard for presentation of information to customers.

## Appendix G –ISO9001 & its Critical Success Factors

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ISO 9001-2000 is an internationally recognised quality management system standard that is based on Deming's plan-do-check-act framework. ISO9001 "promotes the adoption of a process approach when developing, implementing and improving the effectiveness of a quality management system" (44). It serves as a benchmark against which companies can assess their quality management system, and improve it accordingly. Like all QMSs, an ISO 9001-2000 based QMS requires the visualisation of all processes, their appraisal and the comparison of their performance with the desired quality level that maximises customer satisfaction. The results of the process performance comparison along with those of customer satisfaction evaluation allow organisations to determine the areas needing improvement. ISO 9001-2000 is divided into five broad "management principles" which are (44) (53):

- Quality management system
- Management responsibility
- Resource management
- Product realisation
- Measurement, analysis, and improvement

The following critical success factors and hindering factors have been found in recent ISO implementations in Egypt.

**Table 10: Critical Success Factors for transitioning to ISO9001 Quality Management System (48).**

<b>Rank</b>	<b>Changes needed for the transition</b>	<b>Mean</b>	<b>SD</b>
F1	Upper managers clearly announced policies for quality control to all employees	4.77	0.69
F2	Upper managers positively encouraged change in moving towards best quality practices	4.56	0.74
F3	Team leader had strong coordinating and leading ability and worked energetically	4.44	0.81
F4	Upper managers fostered a sense of involvement and commitment from all employees in pursuing ISO 9000: 2000	4.37	0.86
F5	Internal auditors were constantly educated and trained	4.07	0.91
F6	First line employees received systematic education and training	3.98	1.07
F7	Education and training started from upper managers and went down to all employees	3.79	1.09
F8	Employees' training and evaluations were recorded and filed	3.87	1.13
F9	Customer complaints were used as a manner to initiate improvements in the process	3.77	1.13
F10	Upper managers were actively involved in meetings	3.65	1.21
F11	Continuous inter-departmental planning, communication and cooperation were carried out among employees	3.53	1.41
F12	Continuous audits were performed in every department by employees	3.47	1.18
F13	All employees were willing to coordinate with each other	3.40	1.14
F14	Departmental work unit had effective top-down/bottom up communication processes	3.33	1.43
F15	A special department responsible for documents was established	3.29	1.40
F16	An open and trusting working environment was established	3.21	1.42
F17	An inter-departmental team was established to implement ISO	3.11	1.07
F18	Employees received support from their supervisor	3.07	0.93
F19	Employees were highly empowered to make decisions	3.02	0.78
F20	QCC was successfully carried out before implementation	1.12	1.18
F21	TQC was introduced and successfully carried out before implementation	1.02	1.27

**Note:** The mean score is based on participants' level of agreement with each statement on a scale of 1 = strongly disagree to 5 = strongly agree.



**Table 11: Challenges of implementing an ISO9001 Quality Management System (48).**

<b>Rank</b>	<b>Problems</b>	<b>Mean*</b>	<b>Std.Dev.</b>
1	There was a need to change the regular system to fit ISO 9000	3.41	1.01
2	There was a resistance to the introduction of ISO 9000	3.04	1.12
3	Lack of understanding of the importance of ISO 9000 by all departments	2.80	1.04
4	ISO 9000 is time consuming	2.64	1.16
5	ISO 9000 implementation involves high costs	2.58	1.08
6	ISO 9000 involves long and bureaucratic documentation	2.49	0.88
7	The firms lack well-trained and experienced internal auditors	2.35	1.12
8	ISO 9000 standards are vague and complicated	2.19	0.98
9	The surveillance visits are difficult to cope with	2.09	0.77

\*The mean score is based on participants level of agreement with each statement on a scale of 5 = strongly agree, 4 = agree, 3 = neither agree nor disagree, 2 = disagree, and 1 = strongly disagree.

## Appendix H – An overview of Employee Psychology

### 8.1 Abraham Maslow's Hierarchy of Needs

Abraham Maslow developed a theory of personality that has influenced a number of different fields. Human beings have needs which are of a hierarchical nature (30). Maslow proposed that once a lower level need has been satisfied, humans will strive to gain fulfilment in the above level. This theory can be useful when considering individual roles in an organisation allowing management to judge whether the job requirements are meeting the needs of the staff. Creativity, respect by others and a sense of achievement are all key motivational factors that relate to job satisfaction and an employee's level of motivation (31). These factors are displayed in Figure 12.

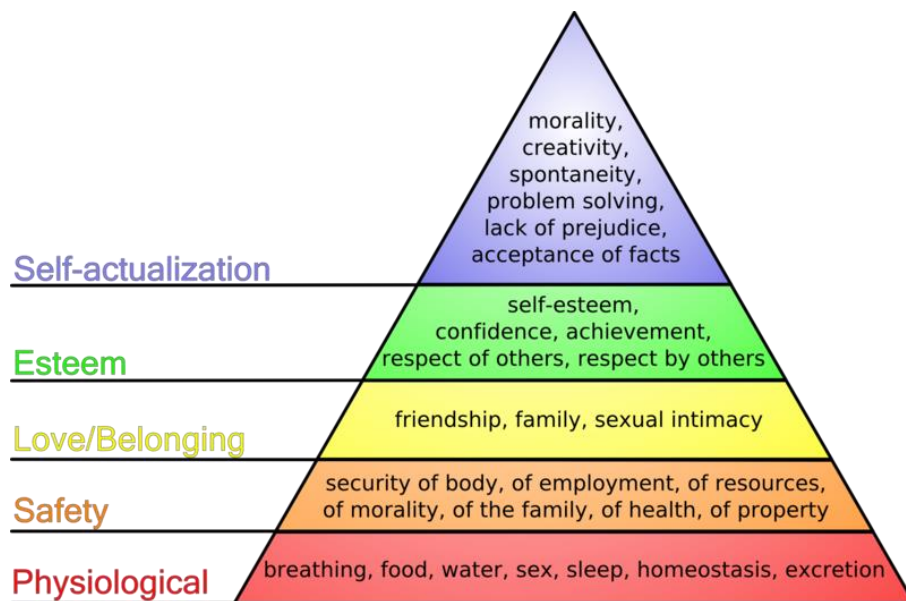


Figure 12: Abraham Maslow's Hierarchy of Needs (32).

### Vroom's Expectancy Theory

Vroom's theory is based on the belief that employee effort will lead to performance and performance will lead to rewards. Rewards may be positive or negative. The more positive the reward the more likely the employee will be highly motivated. Conversely, the more negative the reward the less likely the employee will be motivated (33).

### Action Science

Action Science theory, based on work by Chris Argyris, can be applied to organisational, group and individual learning levels. Learning occurs whenever errors are detected and corrected (single loop

learning) or when the program the produced the error is altered is understood and altered to ensure it is not repeated (double loop learning) (34).

- **Single loop learning:** Lessons learned through changing the behaviour (or system) leading to the failure or unexpected outcome.
- **Double loop learning:** Lessons learned through changing the underlying program which creates the behaviour (or system) which is faulty.

In relation to organisational behaviour, Action Science proposes that errors should be corrected via double loop learning. This ensures a stimulating and work environment is created. Employees can develop their skills and the skills of others to ensure repeat errors do not occur (35).

### ***Theory X and Theory Y***

These two motivational theories provide insight into the influence of management styles on staff motivation. Leadership capability and styles are widely considered a critical variable in the success of small and medium businesses (36). Theory X and theory Y are two polarised categories of assumptions that managers may have about their employees (37).

#### ***Theory X***

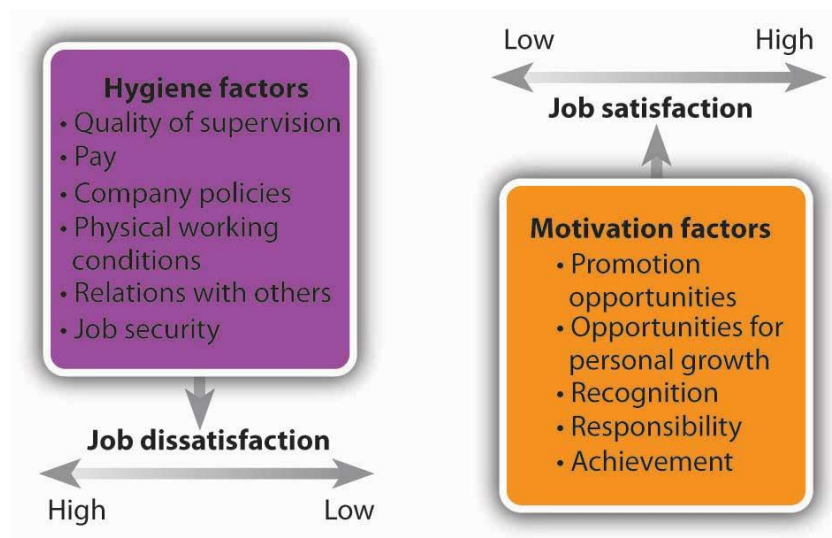
Managers with a Theory X orientation presume employees have negative attitudes about work and their supervisors. Further, Theory X managers believe that employees need to be “controlled, directed, [or] threatened with punishment to get them to put forth the adequate effort toward the achievement of organizational objectives” (37) (38).

#### ***Theory Y***

Managers with a Theory Y orientation believe that employees are motivated to work, strive to build positive relationships with their superiors. Two way communications takes place and employees are asked for input and involved in making workplace decisions. The theory also assumes that employees will seek responsibility and automatically exercise self-direction to work towards an objective (39).

### ***Dual Factor Theory***

Dual factor theory was developed by Fredrick Herzberg in 1959. Recent findings suggest that money and recognition do not appear to be primary sources of motivation in stimulating employees to contribute ideas. This is in line with Herzberg’s predictions; factors associated with intrinsic satisfaction play a more important part (40). Herzberg postulated that employees are influenced by two sources; motivational factors and hygiene factors (41) displayed in Figure 13. When an employee is in the correct environment, job satisfaction is likely to increase significantly, resulting in increased in productivity.



**Figure 13: Herzberg Hygiene Motivation Theory (42)**

With regards to work practices it has been found repetition produces frustration and alienation. Repetition can also induce insight and understanding. If there are no means of accessing this understanding, however, then there are no means of capitalising upon it. Understanding also alleviates the “debilitating effects of repetitive work and its consequences for staff turnover, morale, skill dilution and employee voice” (40). It is therefore crucial understanding is garnered amongst staff at Falcon Electrical when implementing a project management system

## **Appendix I – Electrical Contracting Strategic Analysis**

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Strategic Management Consulting Ltd.

Richard Phillips,

Recent and ongoing regulation changes, economic conditions and developing technologies in the electrical industry are pressuring electrical contractors to provide an integrated range of services to fulfil the requirements of the clients.

This report has been developed to account for these market forces and internal competition within the industry and make recommendations to provide a competitive advantage for Falcon Electrical.

Regards,



Stuart Davidson

Strategic Management Consulting Ltd.

# **COMMERCIAL and INDUSTRIAL ELECTRICAL CONTRACTORS INDUSTRY REPORT PREPARED FOR FALCON ELECTRICAL**

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## **Document Control**

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<b>Version</b>	<b>Author</b>	<b>Distribution List</b>	<b>Date</b>
1.0	Stuart Davidson	Sam Langlands	10/01/2014
1.1	Stuart Davidson	Piet Beukman	14/01/2014
2.0	Stuart Davidson	Piet Beukman	19/01/2014

## **Executive Summary**

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This report has been produced to provide due diligence for Falcon Electrical. It is focused on the commercial and industrial electrical contracting in the Hawke's Bay, and to a lesser extent the central North Island. Areas of this report include:

- Emerging issues and trends within the electrical contracting industry that may affect the operation of contractors over the next 2-10 years.
- The critical success factors for electrical contracting firms and the closely related construction industry.
- Recommended actions for electrical contracting firms to keep their competitive advantage.

The construction industry in NZ is growing with the Canterbury earthquake rebuild, Auckland housing boom and improved infrastructure spending driving this growth. To capitalise on this opportunity, it is recommended that electrical contractors focus on the Critical Success Factors (CSFs) to maintain competitive advantage and increase profitability.

### **Critical Success Factors (CSFs)**

CSFs will ensure Falcon Electrical remains competitive and becomes an industry leader. The highly competitive nature of electrical contracting and the continual development of technology in the industry give the following CSFs:

Ensure quality projects are delivered to the clients: *KRA - improved customer feedback & increased levels of repeat work.*

- A balance between cost, scope and time must be found to ensure the end user clients' concept of quality is met along with the contractors' view of quality also being met.
- Correct scoping and fair pricing of projects will lead to increased trust from contractors and customers.
- By fully understanding the scope of a project (as technology changes, project complexity will generally increase) and being able to deliver the desired outcomes Falcon Electrical's reputation will improve.
- Scheduling involves communicating between divisions in Falcon Electrical to ensure resources and equipment are available to perform projects. Scheduling needs to occur to projects and resources over short term, medium term and long term.
- Monitoring projects is important to ensure quality objectives are met. This includes: speed of work performed, quality of workmanship, progress vs. schedule, changes in scope etc. By monitoring these key result areas and continually informing stakeholders on project progress key relationships can be maintained and developed.

Professionalism must be maintained throughout the company: *KRA - improved brand awareness & employee qualification levels.*

- Basic corporate identity management (uniforms, company communications and updates on recent projects)

- Procedural documentation needs provide guidelines on operational activities and encourage useful but minimum documentation. This will allow information communication to occur clearly and effectively.
- Employee development should include motivating employees and up skilling staff through training on company systems and procedures, technical skills, managerial skills and interpersonal and communication skills.

Company Direction and Guidance (leadership): *KRA - improved change management*

- Leadership within a company impacts the office environment and employee motivation.
- A company vision that aligns with what the contractor ideally achieve over the next ten years.
- A mission statement will give employees direction on how to achieve the company vision.
- Company policies should represent the functional operations that will achieve the company missions.
- Plan-Do-Check-Act (PDCA) cycle used when implementing operational changes.

### **Market Analysis and Emerging Trends**

Trends and impacts likely to affect the electrical contracting industry arise from 3 key factors;

- The improving NZ construction sector
- Increasing awareness of the environment (energy efficiency and renewable energy)
- Technological changes combining with environmental awareness.

A PESTLE analysis combined with a Porter's 5 Forces analysis was used to highlight trends and issues which present threats and opportunities to the commercial and industrial electrical contracting industry:

Opportunities:

- Potential for an oil and gas industry to be developed in the Hawke's Bay / East Coast region. This has the potential to create an industry worth \$360 million and \$18 billion annually to the NZ economy.
- As the population demographic changes (with almost all population growth in Hawke's Bay at 65+) the development of aged care facilities and extra health care facilities will present an opportunity to increase market share and turnover for Falcon Electrical.
- Resource Management Act Amendment (simplifying and stream lining) is aimed to increase development. The Ruataniwha Dam in south Hawke's Bay has been fast tracked as a result and will provide significant opportunity for electrical contracting work over the coming 5 years.
- As environmental awareness increases and technology becomes available (namely solar panels) and financially viable, a large increase in the number of predicted solar panel installations and renewable energy systems is expected.
- Increased use of energy efficient technology is also expected as lighting technologies (LED lights) will see most new construction use this technology. This technology also has the potential for significant retrofit of existing commercial and industrial premises.

Threats:

- Slow population growth, combined with a large age gap (in the 20-35 year olds) may see a shortage of skilled workers and electrical technicians reduce Falcon Electrical's ability to capitalise on opportunities.



- NZ still remains unproductive relative to the construction industry in Australia – if this does not improve it remains more susceptible to the 'boom-bust' cycles it has experienced in the past.
- Rapidly developing technologies will need to be kept abreast with – staff training may need to be increased to ensure knowledge remains on par with customers' expectations.

An important change that could impact the electrical contracting industry is a change of government and the subsequent regulation of the electricity market. This could counter some of the efforts to deregulate the electricity market which has occurred over the past 20 years. As a result significantly lower electricity prices may occur and reduced uptake of energy efficient equipment and renewable (solar) power generation. This will reduce the potential forward workload and increase the competitive forces in the electrical contracting industry.

### **Conclusions**

- To become a leader in the electrical contracting industry, projects must be planned & scoped correctly and then progress must be closely monitored against the plan. This will allow successful project delivery to the clients' expectations.
- The development of oil & gas, irrigation projects, solar energy installations and retirement care facilities will present opportunities over the coming years – relationships & skills within these areas must be maintained & improved.
- Skilled tradesman & technical expertise, combined with customer service skills are the key to gaining repeat electrical contracting & servicing work. Cross training of employees to be skilled in multiple areas will allow for more flexible and responsive resources.
- Leaders must drive changes within a company, with all staff being aware of the reason for change, as the company strives to achieve its visions and missions.

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## 9 Introduction

This report is to present the emerging trends and determine critical success factors which determine the success of an electrical contracting business. The emerging trends that may affect the industry's contractors over the following 2-10 years are explained with the likely consequences highlighted.

## 10 Market Analysis and Emerging Trends

### 10.1 PESTLE Analysis

The below PESTLE Analysis presents the following issues and trends impacting Falcon Electrical alongside the associated *opportunities and threats* for Falcon Electrical:

<b>Political</b>	
Positive (Opportunity)	
Increased support for creation of medium size developments. RMA process restricted to 6 month time limit imposed on city councils (NZ Government).	<i>Proposals of national significance (e.g. the <b>Ruataniwha Dam</b> in Hawke's Bay) are being streamlined and aim to increase the economic activity. This type of project will provide significant industrial electrical work, combined with data networking and automation systems. Develop relationships &amp; <b>enter tendering process with lead contractors.</b></i>
Resource Management (Simplifying and Streamlining) Amendment is designed to reduce the resource consent process for medium size developments and developments of national significance (49).	<i>This could lead to <b>fast tracked development</b> of water irrigation projects and the other oil development projects. Ensure <b>staffing levels are sufficient</b> to meet predicted <b>increased workload.</b></i>
The Government wants New Zealand to become a net exporter of oil and gas by 2030 (50).	<i>An oil and gas industry could be developed in the next decade. Over the coming 2-5 years, oil test wells are likely to appear in the Hawke's Bay region. <b>Develop experience and relationships within the oil and gas industry.</b></i>
Negative (Threat)	
Immigration Policy – Net immigration remains an issue, with more than 40,000 New Zealanders permanently moving overseas during the past 12 months. This may decrease with the slowing economic growth rate in Australia.	<i>If this trend continues, the NZ population growth rate will remain subdued. The population growth in Hawke's Bays is relatively low. The current population is 155,300 growing to 158,340 in 2031 (59). Monitor &amp; allow for <b>slow population growth.</b></i>

<b>Economic</b>	
Positive (Opportunity)	
The construction industry (and associated services) is worth around \$30 billion annually to the NZ economy and is currently beginning a 'boom' cycle. Auckland Housing, leaky homes	<i>If <b>relationships with electrical contractors</b> can be established in <b>Auckland and Christchurch</b>, opportunities to <b>supply</b> and transport electrical <b>switchboards</b> may arise for Falcon Electrical.</i>

and the Canterbury Earthquake rebuild are providing significant sources of demand for construction (52).	
Recovery in gross fixed capital formation or investment by businesses – the construction sector accounts for 50% of all gross fixed capital formation (53).	<i>An <b>increase in construction activity</b> will see <b>demand</b> for electrical contracting services <b>increase</b> over the <b>2014-2017</b> period.</i>
Possible development of an oil industry in Hawke's Bay (similar to Taranaki). Taranaki is "enjoying unprecedented levels of economic activity (62)" The development of oil and gas could contribute between 360 million and 18 billion dollars annually to the NZ economy (55).	<i>An <b>oil prospect</b> is currently underway in Dannevirke (south Hawke's Bay) – there is the potential to <b>offer services</b> to this site (e.g. generator servicing work, general electrical services). <b>Developing knowledge and relationships in this area will be key to securing future work from this potentially large industry.</b></i>
<b>Negative (Threat)</b>	
Construction Sector productivity has been declining for the last two decades. It is low in comparison to most other sectors of the economy and the Australian Construction sector. For instance, New Zealand's labour productivity rate is about 30% below Australia (53)	<i>Steps to <b>improve productivity</b> in the construction industry are already underway. It may be possible to <b>partner</b> with an <b>Australian electrical contracting</b> firm to see their <b>installation processes, project management techniques and general administration</b> as this is a typical weakness of the construction industry in NZ. This will enable the productivity to improve.</i>
Electricity Demand is predicted to grow at 1.1% per annum until 2040 (56) and there is predicted to be significant downward pressure on prices for the next decade. See Appendix A for an overview of electricity demand in NZ.	<i>Reduced electricity prices may <b>delay and reduce</b> the <b>uptake of renewable energy</b> power generation and installation rates of energy efficient lighting and heating technologies in existing buildings. The low growth rate is due to more energy efficient technologies being installed in new construction projects.</i>

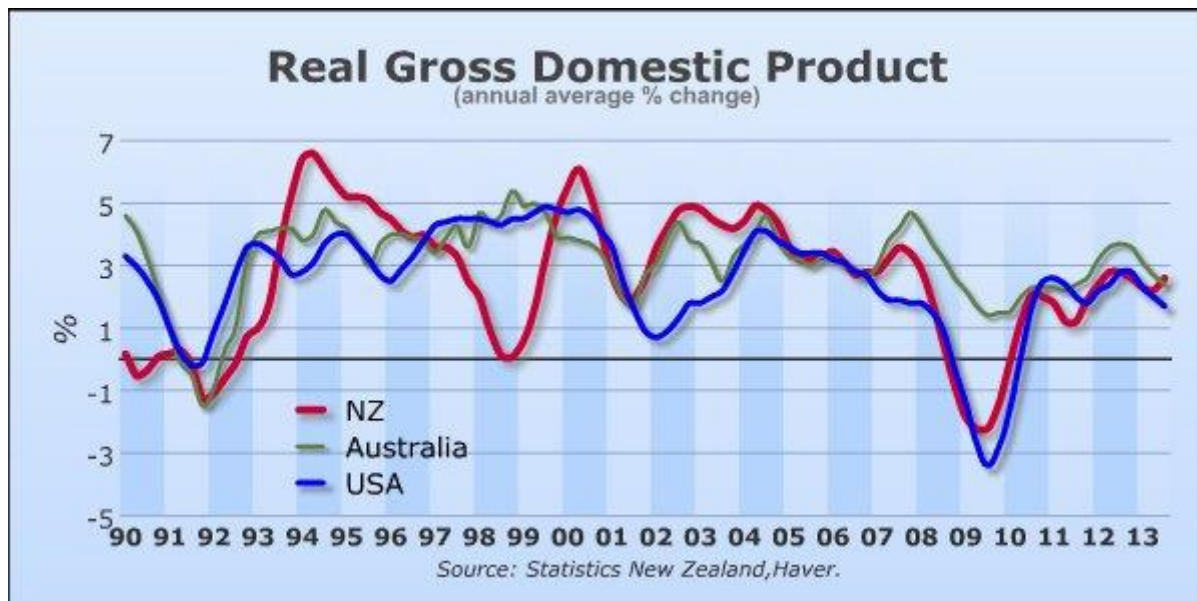


Figure 14: NZs and major trading partner's economic growth (57).

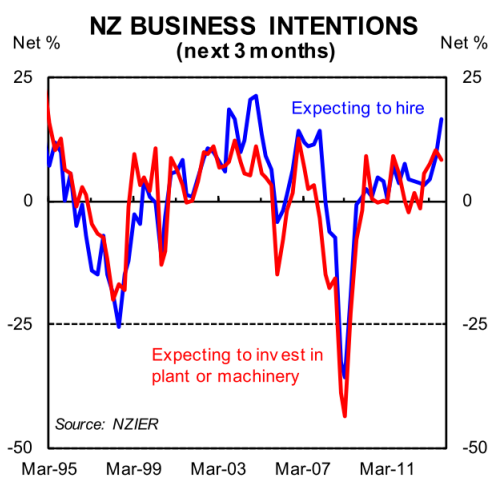


Figure 15: NZ Business Hiring Intentions

<b>Socio-Cultural</b>	
<b>Positive (Opportunity)</b>	
Population Growth / Ageing Population – Hawke's Bay is a popular retirement destination. Almost all population growth is at 65+ years (59).	<p>An ageing population may lead to an <b>increased need for hospital facilities and retirement care facilities</b>. Key relationships need to be further developed with the Hawke's Bay District Health Board (HBDHB) and Retirement home operators.</p> <p><b>Falcon Electrical's relationship needs to be</b></p>

	<i>developed with the HBDHB by delivering professional, successful projects. – this will put them in a favourable light for future tender processes.</i>
Safety Awareness - As ageing workplaces and machinery (with aged and unsafe equipment) are upgraded or refurbished, increased focus on safe electrical design is required (58).	<i>The use of safety barriers, guards and lock-out controls will increase. <b>This will result in increased electrical componentry and associated electrical contracting work.</b></i>
Influence of the internet and development of high speed broadband.	<i>Use of computer based equipment and machinery will increase. This will result in increasingly complex electrical and data transfer systems. <b>Staff training may need to be increased to maintain pace with technology.</b></i>  <i>Contractors will be judged and reviews on the level of service will be given online. The use of sites such as nocowboys.co.nz which has 35,000 ratings of NZ contractors will determine the success of contracting firms. <b>Failures in the quality of service will become public knowledge very quickly.</b></i>
Environmental awareness and the drive for sustainable construction is increasing (53)	<i>The use of solar energy and renewable energy power generation is likely to increase in residential and small commercial properties. However this form of technology is not yet economic for industrial sites. <b>The need to stay abreast with the latest proven technologies and techniques is essential to remain competitive in this changing environment.</b></i>
<b>Negative (Threat)</b>	
Migration away from rural centres (e.g. Wairoa, Central Hawke's Bay etc.) will see population base in Napier and Hastings increase and the population in Wairoa and Central Hawke's Bay decrease (59).	<i>The migration away from the rural areas and centres is likely to see the <b>closure of more agriculture based processing plants.</b> This will result in loss of some large industrial plants and the associated electrical contracting work involved with the maintenance of these plants. This potential loss of business should be planned for over the next 5-10 years.</i>
In Hawke's Bay, there is a gap in the population (hour glass curve) between the ages of significant net migration loss at 20-34 years (59). See Figure 16.	<i>The loss of population in this age bracket results in the loss of some relatively young and talented workers. This may lead to difficulties in finding skilled staff, or suitable apprentices to train. <b>An opportunity to attract skilled staff may be through school careers expo's to attract talented apprentices.</b></i>
Changing customer types and needs. This includes more knowledgeable customers.	<i>Employees must remain up to date and knowledgeable with current technologies.</i>

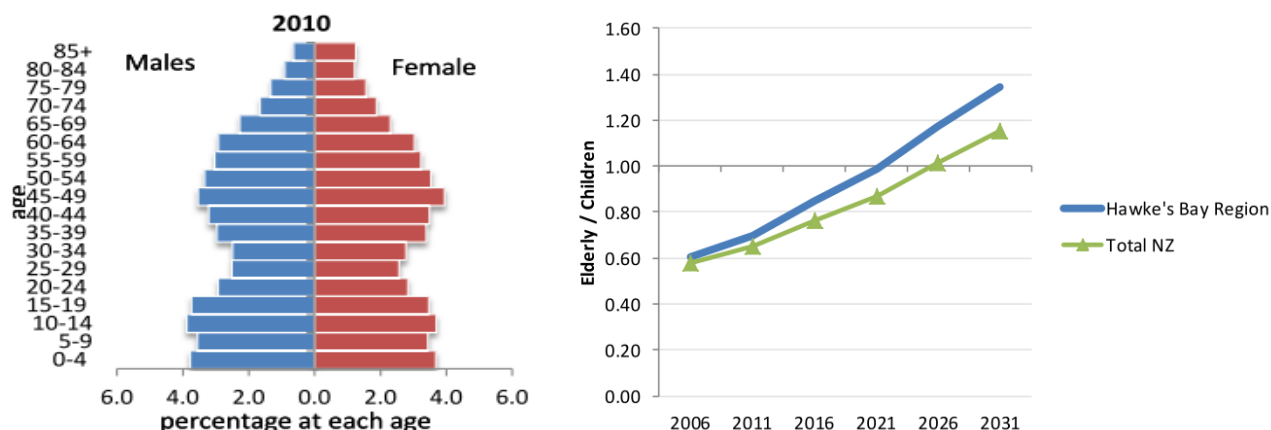


Figure 16: Hawke's Bay age distribution and forecast elderly/children ratio (59). Predicted to go 'top heavy' in future years.

<b>Technological</b>	
Positive (Opportunity)	
Increased Plant Automation and use of Programmable Logic Controllers (PLCs), Variable Speed Drives (VSDs) and site wide Supervisory Control And Data Acquisition systems (SCADA). This is primarily to reduce labour costs in labour intensive production processes. Automation allows for increased product quality, improved monitoring better quality control.	<i>The <b>increased use of these plant automation systems will see smaller industrial and commercial companies require installation assistance</b>, along with associated ongoing servicing. Falcon Electrical's certification as a Rockwell Automation System Integrator will see it lead the installation of these devices.</i>



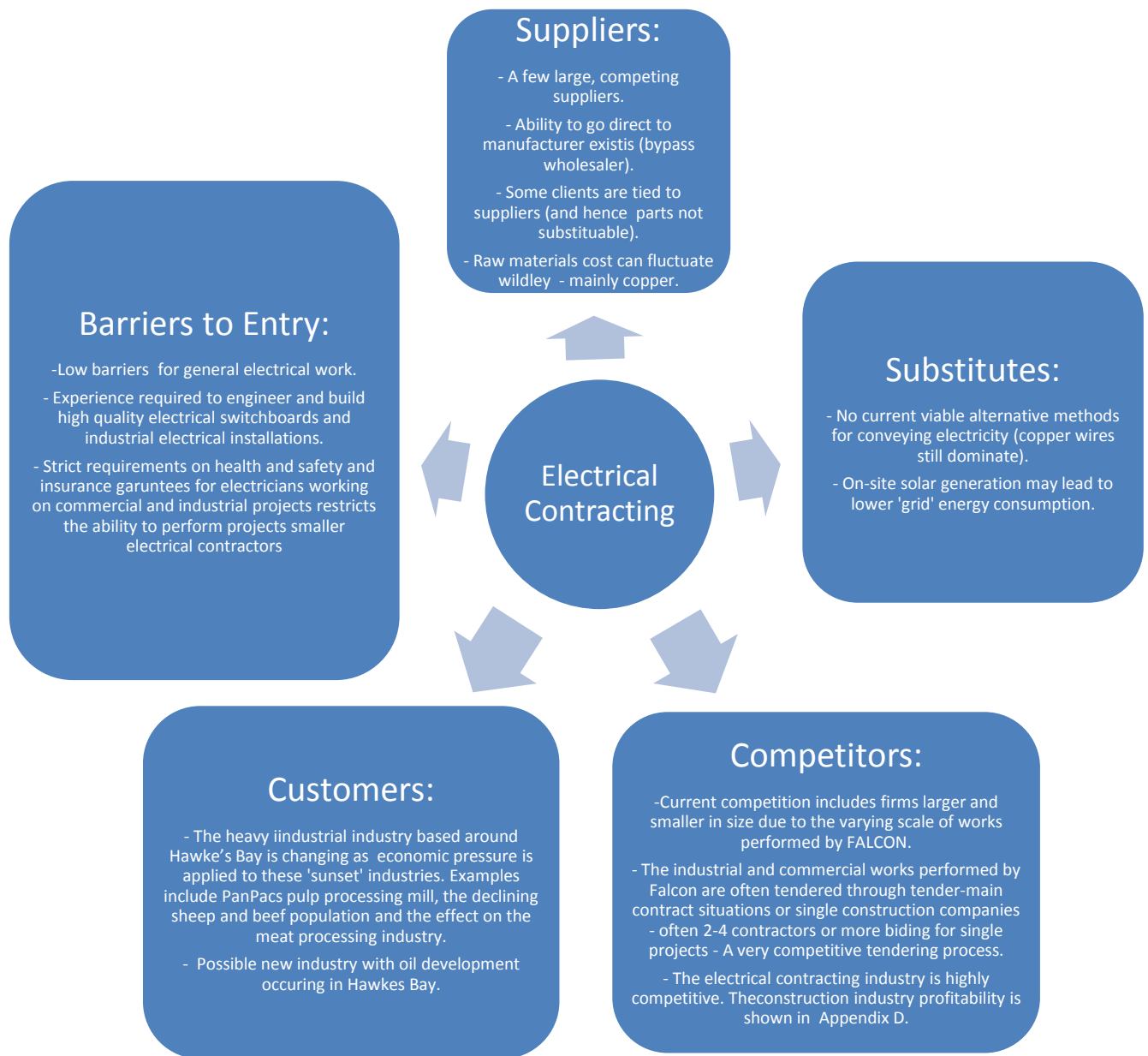
The development of energy efficient lighting technologies (LEDs primarily). These lighting technologies are beginning to dominate all commercial and industrial installations (59).	<b>Replacement of fluorescent, mercury vapour and HID Metal Halide lights could provide significant levels of electrical refit work</b> as the large cool store and food processing operations in Hawke's Bay upgrade their lighting technology.
Advanced building energy management systems are becoming standard. Emphasis on 'the right light, in the right space, at the right time'	Increased use of <b>automated light controls/sensors</b> and <b>intelligent HVAC systems</b> will create opportunities to <b>install these systems in the refit of existing buildings</b> . Knowledge in this area must be maintained & improved.
<b>Negative (Threat)</b>	
Constantly changing and developing technologies could require increased levels of staff training	<b>Higher employee training costs could be incurred</b> with more time off required for staff to attend training courses. <b>Monitor training costs &amp; the effectiveness of training.</b>
Cross pollination of industries could see the data and AV companies begin to perform other electrical contracting services	<b>By providing other electrical building services</b> (and offering ongoing support) for the installation and maintenance of data networks, fire systems and other essential buildings services, <b>Falcon Electrical will be able to offset competition from other trades trying to perform the electrical contracting work.</b>

<b>Legal</b>	
<b>Positive (Opportunity)</b>	
Protecting design work and abilities is recognised as an important competitive advantage in the industrial electrical contractors industry. The engineering work done in the quoting stages must be protected. Also the privacy of customers' security information is a crucial to the success of any security company.	Information is to be <b>stored primarily on the Falcon networked file store</b> , however information (particularly security sensitive information) is often required <b>off site</b> for installation, commissioning and maintenance. <b>The information should be protected through the use of encrypted hard drives.</b>
<b>Negative (Threat)</b>	
Changes to electricity regulations if a Labour led government is elected in 2014. Significant government interference with the electricity prices (and monthly bills paid by households) could reduce the price paid by electricity consumers.	<i>The strong regulations proposed could create uncertainty for companies looking to invest in New Zealand for power generation.</i>  <b>The lower cost of power</b> for residential premises has the potential to <b>disrupt the uptake of energy efficient appliances and lighting</b> as power prices remain lower. <b>Allow for reduced renewable energy uptake if a Labour led government is elected &amp; chooses to regulate electricity prices.</b>
Privacy of information is becoming a key issue in NZ. All information about human beings is protected by the Privacy Act 1993 (60). An	<b>All information held on staff, customers, suppliers and other stakeholders must be handled privately and correctly.</b> The storage of

example of this is the recent ACC, EQC and WINZ privacy breaches	<i>information should be controlled, with appropriate access to managerial, administrative and operational staff provided. <b>This should be highlighted in staff inductions</b> and if any changes occur then all staff should be duly notified through ongoing education.</i>
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<b>Environmental</b>	
Positive (Opportunity)	
Climate change is predicted to impact Hawke's Bay. The temperature is predicted to increase by 2.1 °C by the end of the century (61).	<i>The higher temperature and sunshine hours could lead to higher levels of solar radiation from the sun. Falcon needs to continue to supply Solar Electrical systems to ensure it can take advantage of this trend.</i>
Concern about climate change and limits on fossil fuel reserves is driving the development and uptake of even more renewable energy technologies to generate electricity, provide heating, and power our vehicles.	<i>Uptake of <b>small scale solar and hydro</b> generation schemes is predicted to increase. <b>A knowledge and skill base</b> associated within this growing industry <b>should be developed</b>.</i>
Negative (Threat)	
Strong local resistance to developing an oil industry on the east coast. The use of fracking has been associated with causing earthquakes, water pollution and environmental issues. (50)	<i>This <b>resistance</b> could lead to <b>reduced or delayed development of oil fields</b> as regulations to control the industry are developed by local and national government. Time training &amp; development of skills in the oil &amp; gas industry to be ready for development.</i>

## 10.2 Porter's 5 Forces Analysis



**Figure 17: Porters 5 Forces overview for Industrial / Commercial Electrical Contracting Projects**

### Threats:

- Following the recent global financial crisis, more self-employed contractors are operating due to the low barriers to entry in this market. These operations do not pose a threat to large commercial / industrial jobs, but with labour becoming available through the labour contracting firms, these small firms may be able to increase their workforce size through the use of temporary labour.

- Increased competition in the industrial & commercial contracting industry since 2008 as the global financial crisis has reduced the levels of construction activity.
- Cost of raw materials (copper mainly) is subject to fluctuations based on the world price. This can lead to losses on jobs as the cost can vary radically. All significant copper purchases & quotes should have strict expiration dates (short term) as it may lead to unforeseen expenses in projects.
- Companies focusing on data and security systems may cross pollenate begin to offer other electrical contracting services and encroach on existing market share.

Opportunities:

- Developing renewable energy installation skills and techniques.
- Increasing the installation abilities of data networking, fire and security services as this will be an increasing component of future electrical contracting works.
- Continue to develop relationships & knowledge of machinery with heavy industrial customers to become the preferred electrical contractor for project work and servicing work.

### 10.3 Competitor Analysis

In Hawke's Bay and the Central North Island, there are multiple electrical contracting firms offering industrial and commercial electrical services. An analysis of the competitors can be found in Appendix D – Competitors Analysis.

## 11 Critical Success Factors (CSFs)

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### 11.1 Construction Project Principles that drive Industry CSFs

Typically for construction projects, cost is the determining factor for the contractor that Falcon is subcontracted to. Cost, time and scope are the key factors for the end user client that determine the quality and project success.



**Figure 18: A view of customer's expectations on cost, scope and time and its impact on quality.**

Depending on the end user client's expectations, the project may, or may not meet the desired quality levels. For example a change in scope may lead to cost increases and scheduling delays, leading to a lower perception of quality by the client. By correctly scoping a project, preparing honest and fair bids

with items tagged out<sup>1</sup> Falcon Electrical will see its reputation as a contractor, who correctly understands the project scope and complexity, improve.

Correctly pricing projects at the tendering stage (rather than tender low and tack on multiple variations) Falcon Electrical may be pushed out on some project purely on price. A balance needs to be found as this may lead to a loss of some projects; on the other hand it will see other projects performed with fewer variations (and less associated costs with managing variations). More effective relationships will develop with the local construction companies as Falcon Electrical provides consistency and reliable service, fair and competitive prices and projects that meet clients' expectations.

## **11.2 Electrical Contractors CSFs**

### **11.2.1 Safety**

Injuries on New Zealand construction sites most frequently occur due to falling from heights, fumes, inexperience or lack of understanding of the NZ health and safety standards (62). The clear track record of safety for electrical contractors is seen as a basic pre-requisite to being considered to perform work for a project. This is because the safety of contractors and subcontractors is now the responsibility of the principal on all construction and manufacturing sites.

### **11.2.2 Professionalism**

The ability to establish professional project management techniques with multiple contractors will enable relationships to develop and trust to be built.

#### **11.2.2.1 Image - Corporate Identity Management (CIM)**

The role of CIM is to establish a favourable reputation with an organisation's stakeholders and increase the propensity to buy that organisations products and services (63). This is particularly important to construction and service companies as a poorly represented company is often associated with unprofessional service, poor organisation and low quality products. The following basics are to ensure company image is upheld:

- Company advertising must be consistent (logos, slogans etc.)
- Employee uniforms must be tidy and consistent
- The company should regularly update customers with on projects it is involved with and any other company achievements – potentially through an emailing list.

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<sup>1</sup> Tagging-out refers to discrepancies in drawings, schedules and timelines which the contractor notices during the tendering process. The tagged-out item may not be functional, no-longer available, not maintainable or not installable etc.

#### **11.2.2.2 Documentation**

Good procedural documentation will accelerate projects, fostering support at all levels of management and greatly improve project communications (64). Good documentation should:

- Provide guidelines and uniformity
- Encourage useful, but minimum, documentation
- Communicate information clearly and effectively
- Standardise data formats
- Unify project teams
- Ensure document agreements for future reference
- Minimize conflict and confusion
- Build and record experiences and methods for future projects

#### **11.2.2.3 Employee Development & Motivation**

Motivating the workforce is one of the most critical challenges facing organisations today (65). Investment in employee development represents a high-commitment strategy that affects employee commitment and motivation (66). Industry training leads to higher incomes and charge out rates for skilled electrical technicians and engineers (see appendix B). Effective employee development and training can lead to lower staff turnover rates (67). The following skills should be developed to improve employee morale and company performance:

- Company systems and procedures
- Technical skills (installation, programming, administration)
- Managerial skills (project management, employee management)
- Interpersonal and communication skills.

#### **11.2.3 Productivity**

Productivity in the construction sector in NZ has lagged behind that of Australia's. This is due to the lack of large firms which does not allow for economies of scale (53). To improve productivity a key aspect is the management and administration of projects in the Construction Industry (53).

#### **11.2.4 Planning, Scheduling and Monitoring Projects**

##### **11.2.4.1 Planning**

The planning stage of electrical works involves significant amounts of work and will determine if the project is a success in the eyes of the client, and if the project is a success in the view of the electrical contractor performing the work. By correctly scoping the works to be performed, and creating a logical work breakdown structure for the tasks to be performed, a project can be priced correctly and a 'fair' profit can be made. The use of tools such as Microsoft Project and a project management system

(such as SimPro) can lead to significant productivity gains and increases on the ability of the employees to perform work efficiently.

#### ***11.2.4.2 Scheduling***

By predicting the forward workload, a subcontractor is better able to manage resource levels and enable timely and correct completion of projects and servicing jobs. The ability to plan and prepare materials and work instructions for employees enables smooth and clear flows of information. This enables the project to be completed with the correct equipment, at the correct time at the correct location.

#### ***11.2.4.3 Monitoring***

Monitoring projects is the essence of project management, as undoubtedly, the project requirements and specifications will vary as the project is taken from a set of drawings to a construction site and to a project handed over to a client. A key aspect of success in the electrical contractors industry is to monitor the following:

- Work performed
- Speed of work performed
- Quality of workmanship
- Comparison of project progress against schedule
- Project closeout
- Project budget variations
- Changes in the project scope.

Stakeholders involved with projects should continually be informed of the project progress. Project progress can seem tediously slow when stakeholders are uninformed of the works being performed by contractors. By updating clients on progress made by the contractor, key relationships can be maintained and developed.

### ***11.3 Clear Agreement on the Scope of Works***

Alongside delays in decision making and financial difficulties, changes in scope are a leading cause in preventing successful projects. Electrical contracting firms should constantly monitor the scope of the projects that they undertake. Cost overruns are often associated with underestimating the project scope. Also client dissatisfaction comes from inadequate design as engineers are often not aware of all the clients' requirements and the 'why' behind the project (68).

- Involve all stakeholders
- Keep a record of requirements
- Monitor changes in scope
- Maintain open communication channels

- Document all changes agreed

## **11.4 Company Direction and Guidance (Leadership)**

### **11.4.1 Company Direction and Strategy**

The way in which an electrical contracting firm is operated will have impacts on its performance. Issues such as organisational culture, office environment and relationship with clients can combine to set a contractor up as an industry leader. A successful contracting firm should establish the following:

1. A company vision that aligns with what the contractor ideally could achieve over the future years.
2. A clear mission statement will give both employees and clients an idea of the contractors' methods and direction. This should encompass how the company plans to achieve its mission statement.

## **12 Conclusions**

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The material presented in this report describes the CSFs and emerging trends and issues which may impact on the industrial and commercial electrical contracting industry. The following conclusions can be made:

- To become a leader in the industrial and commercial contracting industries projects must be planned, scheduled and monitored.
- The correct scoping of projects will lead to improved project quality in the eyes of the client and more profitable projects operated for Falcon Electrical.
- Maintaining professionalism is an important part of being an industry leader.
- Increasing environmental awareness is likely to lead to significant opportunities with increases in renewable energy installations and increases in the installation of energy efficient lighting technologies.
- If an oil and gas industry is developed in the Hawke's Bay, it is important to be well skilled and resourced. Relationships with companies in the industry also need to be developed.
- The ageing population in Hawke's Bay will present opportunities in the development of healthcare facilities and threaten the availability of skilled and talented employees for the workforce.
- A well trained, technically skilled workforce with customer service skills is key to maintaining ongoing service contracts.



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## Appendix A – Electricity Demand Overview

In 2010, grid electricity demand peaked close to 39 TWh per annum. In the Mixed Renewables scenario, it does not significantly exceed that level until 2016, and no new investment (other than projects already committed) takes place until 2020. Even in the High Growth sensitivity, no new investment is required until 2017, given the amount of new generation already under construction. If all other factors are held constant, continued low demand growth and excess supply should delay the need for new generation, substantially reducing pressure on electricity prices (see page 10).

However, in the longer term, an increase in demand will mean we need new generation

- See Figure 19. In our Mixed Renewable scenario, total electricity demand grows on average by 1.1% per annum to 2040 (grid demand is over 50 TWh in 2040). This compares with an average growth rate of 1.3% per annum in our High Growth sensitivity and of 0.9% per annum in our Low Growth sensitivity (56).

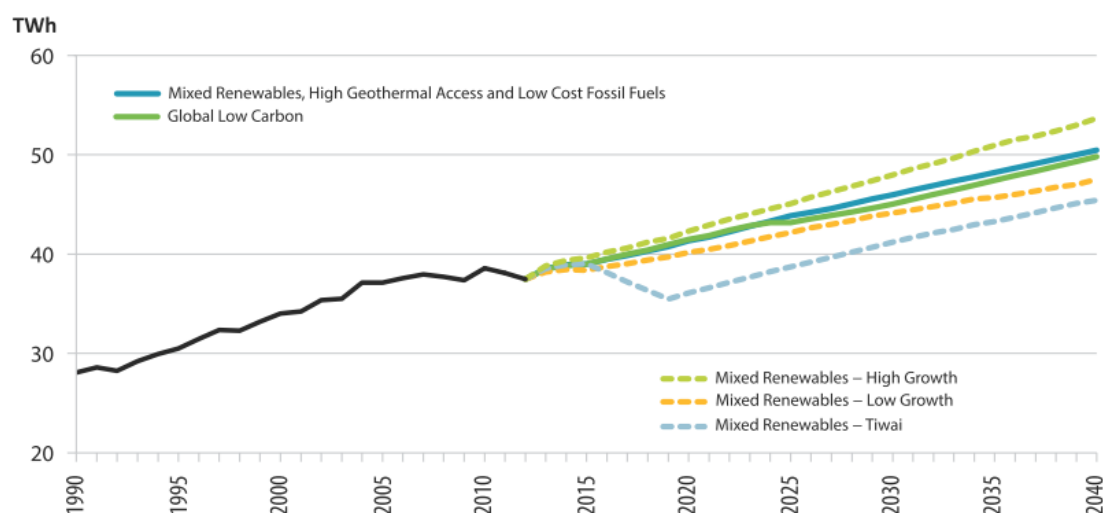


Figure 19: Grid level electricity demand (56).

## Appendix B – Employee training and labour turnover

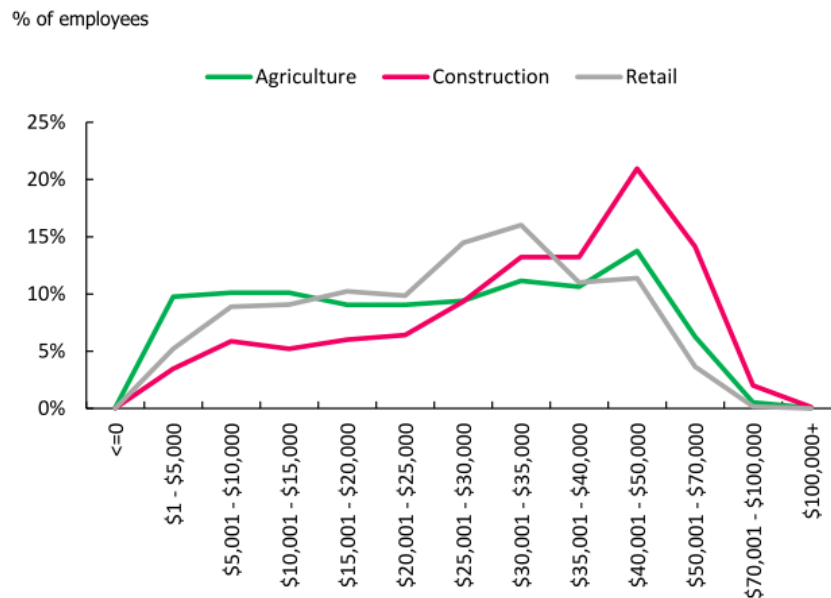


Figure 20: Distribution of annual income: no formal qualifications but has undertaken training (69).

Wage inflation is also correlated to staff turnover:

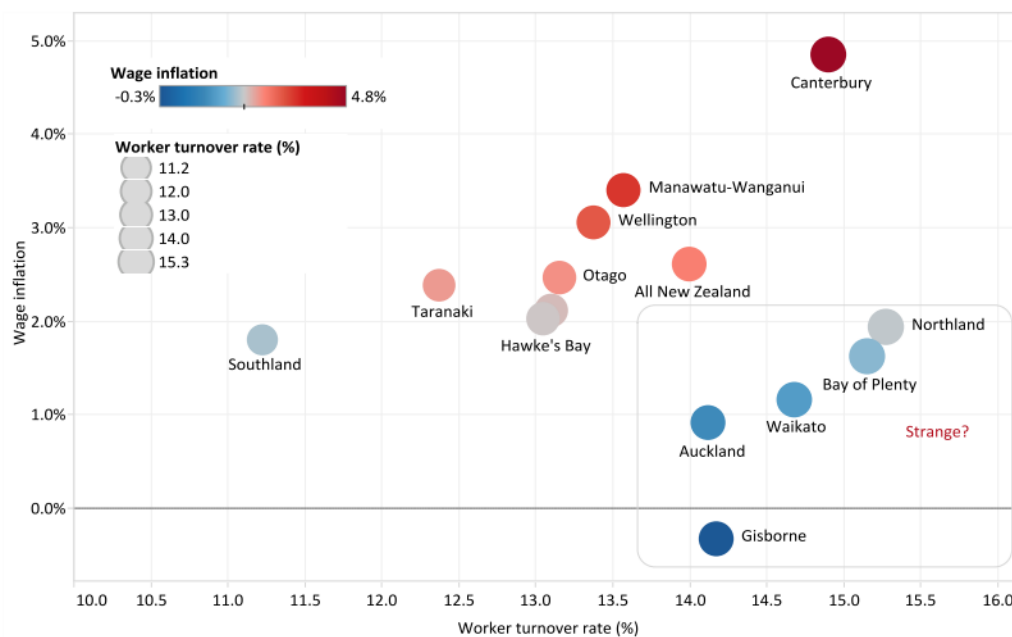
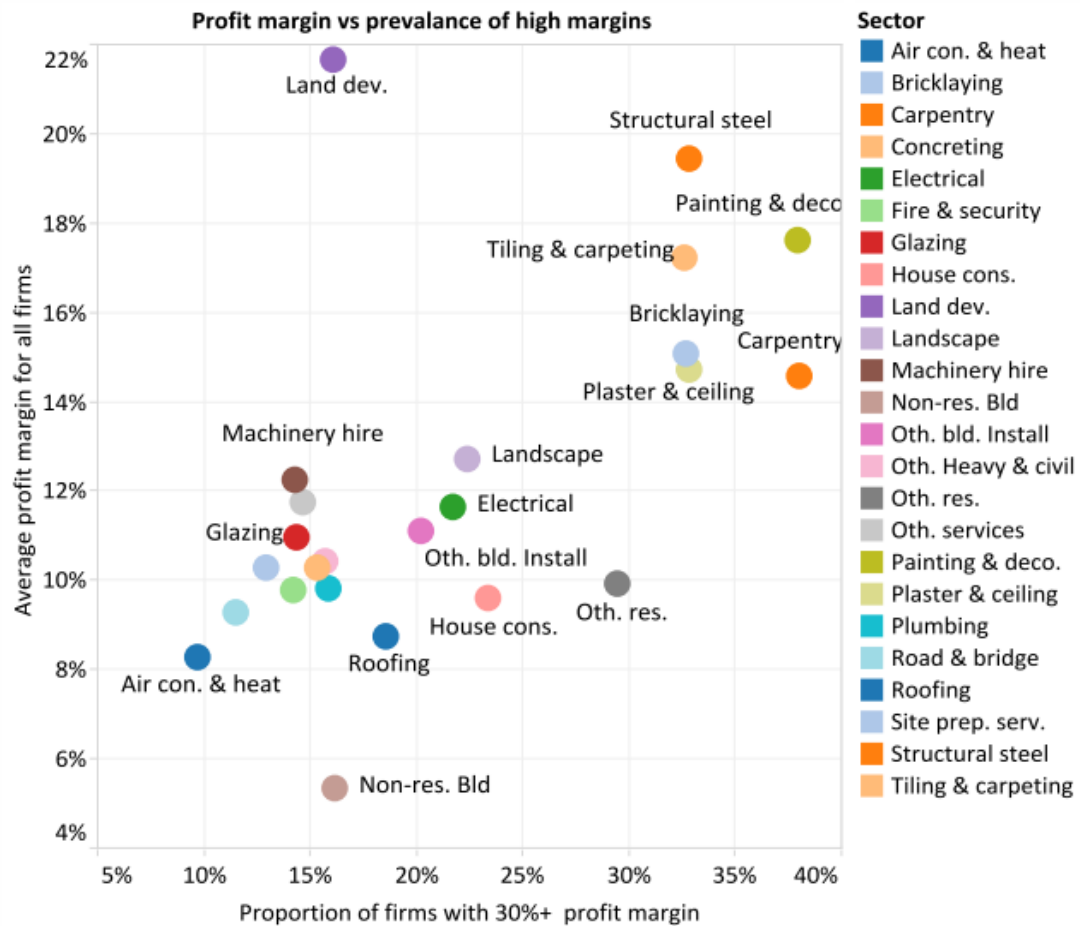


Figure 21: Wage inflation and labour turnover (69).

## Appendix C – Construction Profitability Margins

Vertical scale is average profit margin for all firms; horizontal scale is proportion of firms with 30%+ profit margin



**Figure 22: Construction industry profitability margins.**

## Appendix D – Competitors Analysis

1	Low Threat - offers 1 or less similar services in the electrical contracting business & operates within the Central North Island.
2	Medium Threat - Offers more than 1 similar electrical contracting service in the Central North Island
3	High Threat - Offers 2 or more similar electrical contracting services in the Hawkes Bay region.

### Hawke's Bay

#	Threat Level (1-3)	Company Name	Electrical Services Offered
1	3	Pope Electrical	Industrial, Commercial, Automation Controls
2	1	Kayrod Services Ltd	Renewable
3	1	BFT Automation	Automation Controls
4	1	Scanpower	Commercial
5	3	Best-Forsyth Electrical	Automation, Commercial, Industrial, Domestic, Switchboards
6	3	Kinetic Electrical	Industrial, Commercial, Automation Controls
7	2	Power on Electrical	Commercial, Industrial
8	3	Laser Electrical	Commercial, Industrial, Data, Security
9	1	Isaacs Electrical & Plumbing Ltd	Commercial, Rural
10	1	Alexander Electric	Commercial, Residential
11	2	Chubb NZ	Security, Fire
12	3	Bruce Moroney	Industrial, Commercial, Residential
13	3	Electrotech Controls Ltd	Industrial, Commercial, Automation, Surveillance, Fire, Data

### Manawatu

#	Threat Level (1-3)	Company Name	Electrical Services Offered
14	2	McNae Electrical Solutions	Security, Industrial, Commercial, Automation, Residential, Renewable
15	2	Couchmans Electrical	Residential, Commercial, Industrial, Data, Renewable
16	2	Maxtarr	Industrial, Commercial, Security, Fire
17	1	Johnson Electrical	Commercial, Residential
18	2	Anderson Automation Controls	Automation, Industrial
19	2	B&M Electrical	Commercial, Industrial, Residential
20	1	Bradely Electrical Ltd	Residential, Commercial
21	1	Patterson Electrical	Residential, Commercial
22	2	Knowles Electrical	Residential, Commercial

