HARVESTING TECHNICAL NOTE

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Rigging Configurations used in New Zealand Cable Logging

Summary

One of the most common challenges in cable logging operations is deciding when and where to use different rigging configurations; furthermore, what gear (carriage and rigging) to pair with the chosen configuration. In order to gain a better understanding of these principles or 'rules of thumb' a two part study was conducted. This report presents the findings of the first part which was to collect and pool knowledge from experienced logging personnel using a structured questionnaire. The survey included company planners, yarder operators, crew leaders and owners. The summary of the survey responses is presented, including who was surveyed, what rigging configurations are currently being used, and the perceived advantages and disadvantages of the main rigging options. This information helped establish a baseline for the second part of the project, using additional expert input as well as technical manuals to synthesize common elements regarding which rigging configuration is best suited to various operating conditions.

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INTRODUCTION

There are a number of cable logging texts describing the various rigging configurations, such as the *Best Practice Guidelines for Cable Logging* (FITEC 2000), LIRA *Cable Logging Handbook* (Liley 1983), and *Yarding and Loading Handbook* by Oregon Occupational Safety and Health Division (OR-OSHA 1993). More detail on cable mechanics can be found in texts such as *Cable Logging Systems* (Studier and Binkley 1974) and *Winch and Cable Systems* (Samset 1985). Some websites also provide basic information on rigging configurations and payload calculations (e.g. www.cnr.vt.edu/visser/cable_logging/).

There are also many documents which provide detailed information about safety for workers in cable logging operations, such as the *Approved Code of Practice for Safety and Health in Forest Operations* (Department of Labour, 1999), the *Best Practice Guidelines for Cable Logging* (FITEC 2000), the *Cable Yarding Systems Handbook* (WorkSafeBC 2006) or OSHA's *Oregon Bush Code* (OR-OSHA 2008). However, very few provide any detailed information as to what system will be more productive, or safer, under specific stand and terrain conditions.

The overall goal of the study was to address one of the most common challenges in cable logging: deciding which cable logging system and which carriage and rigging configuration to use depending on the operating conditions. In any location more than one rigging configuration is likely to be viable. Ideally, the most cost-effective and safe configuration is chosen based on stand and terrain information matched to the yarding machine capability. However, crews have a tendency to work with one or more configurations they are most familiar with (Tuor, *pers. com*.). For example, to optimise productivity more than one rigging system might be used for different parts of each harvest area, according to available deflection and distances to be extracted (Visser *et al.* 2000). Introducing a mechanical or mechanised carriage where appropriate can also improve production (Prebble, 1990; Palmer 1995; Palmer and Robinson, 1998).

It is recognised that one of the best sources of information resides with the experienced owners, operators and planners in the industry. Therefore, this first part of the study collected and pooled knowledge from experienced people in varying regions and operations throughout New Zealand.

METHOD

A questionnaire was developed and interviews were conducted in person in a number of regions across New Zealand. Brian Tuor from Oregon, an international cable logging consultant experienced in New Zealand operations, also responded to the questionnaire. All people who contributed had the option to remain anonymous. Basic information collected included; job title, company worked for, equipment owned, and which rigging configurations respondents were most familiar with. Then the advantages and disadvantages of each rigging configuration were noted. Finally some terrain scenarios were discussed in terms of which rigging

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configuration might be best suited. Each of the interviews asked the same questions in the same order so that the answers could be easily compared from person to person and region to region.

Survey Participation

Thirty-seven interviews were conducted, from seven different regions (Figure 1). Most (60%) were from the South Island, while the most heavily sampled regions were Gisborne (10 interviews), Otago / Southland (10) and Nelson (8).

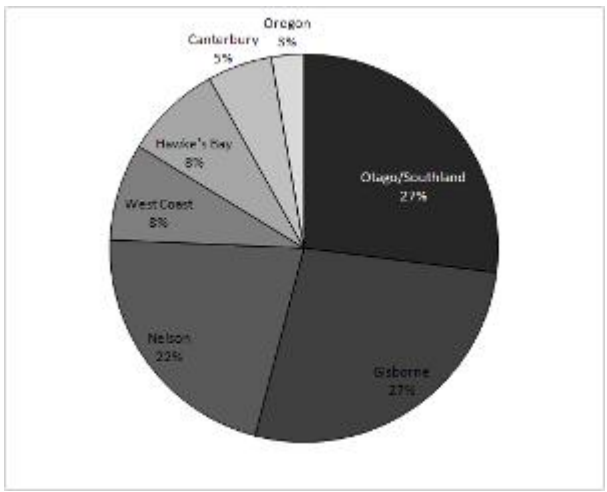

Figure 1: Regional spread of survey participants

Figure 2 shows the job role of the survey participants. The majority of interviews were with crew owners who acted as on-site crew leader (35%), followed by company planners (27%), and crew leaders/foremen (24%).

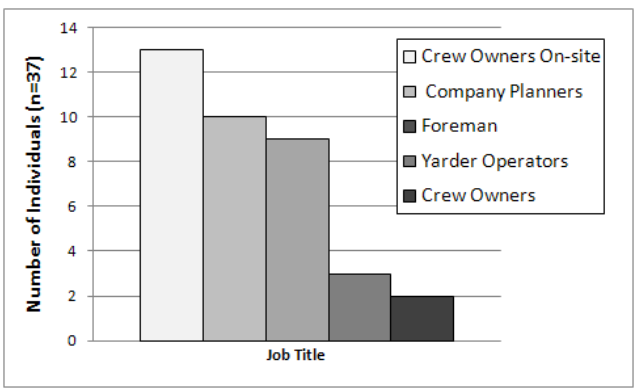

Figure 2: Job role of survey participants

RESULTS

Use and Knowledge of Rigging Configurations

When asked which rigging configuration they most often used, 49% of respondents stated North Bend (Figure 3), while the second most common configuration was scab skyline (Grabinski) – 22% – followed closely by shotgun (gravity return) – 19%.

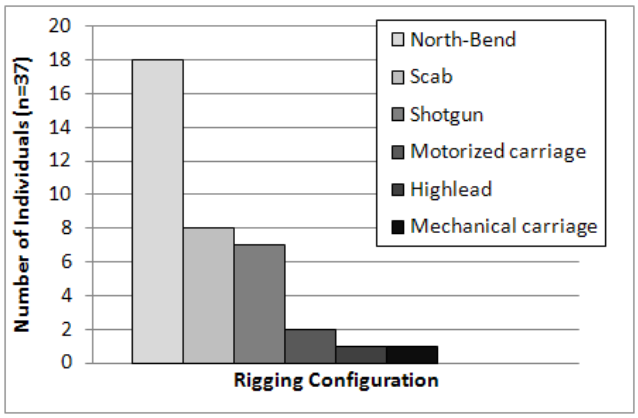

Figure 3: Rigging configuration most often used

Despite the popularity of the North Bend system most had used various other rigging configurations in the last five years. More than 70% of survey participants said they had used Scab, Highlead, North Bend and Shotgun within the last five years. However less than 25% said they had used any of the other rigging configurations, including either motorized carriages or mechanical slack pulling carriages, or grapples within the last 5 years (Figure 4).

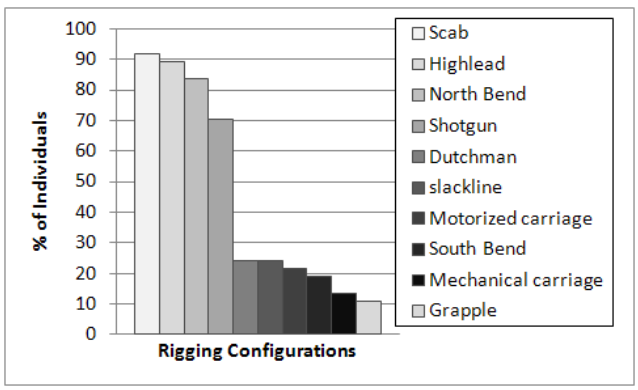

Figure 4: Recent use of various rigging configurations (within the last 5 years).

Survey participants may have been less likely to use alternate rigging configurations depending on terrain

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suitability or availability of skilled personnel or correct equipment. However, the data indicated that they may have been deterred from using alternative rigging configurations because of their lack of knowledge or experience.

In his response Brian Tuor concluded with the following statement: “In my experience, systems are often chosen not based on any or all of the criteria but on what the crew knows and are familiar with. This is not always bad, because given the wide overlaps in applicability of the systems, a crew is often more productive and safer using the system they know and are familiar with without trying to learn and adapt to a new system. However this tendency keeps the crews from learning new and often more appropriate systems.”

Figure 5 shows the rigging configurations of which survey participants had limited knowledge. Most respondents (60%) said they had limited knowledge of mechanical carriages (mechanical slack pulling or MSP carriages). This finding was corroborated when only 15% of respondents said they had used one in the last 5 years. Other configurations and equipment of which survey participants had limited knowledge were Dutchman (45% of participants) and Grapples (less than 30% of participants) both of which had limited use by study participants over the last 5 years.

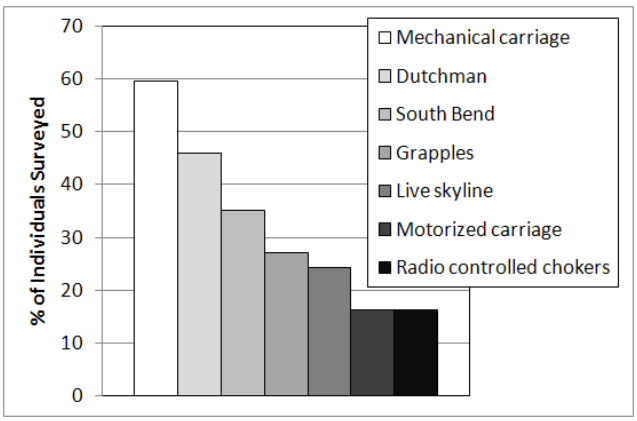

Figure 5: Rigging configurations of which survey participants had least knowledge.

In some cases it is understandable that there is little knowledge of a system if it is not commonly used. An example is a Dutchman, sometimes called sideblocking, where a block through which the tail rope or main rope runs is anchored to a stump to change the direction of haul to avoid obstacles.

Advantages and Disadvantages of Common Configurations

Some of the most informative and interesting results came from the discussions about the advantages and disadvantages associated with different rigging configurations and equipment.

The following tables summarise these findings for the four best known and most often used rigging configurations: North Bend, Scab Skyline, Highlead and Shotgun.

North Bend

Named after the North Bend Lumber Company in North Bend, Washington where it was first introduced in 1912, this system has had extensive use throughout the world. The survey showed it to be the configuration most often used, the main reason being its simplicity and versatility and ability to yard laterally through bridling (anchoring the tail rope laterally to the skyline which enables the butt rigging to move away from the skyline when it is hauled back). The system can be used in either uphill or downhill yarding.

North Bend skyline can be operated by a 2-drum hauler (with a standing skyline), but normally requires a 3-drum hauler. Other common advantages were its increased lift giving good productivity and payload capability, and crews found it hard to break while still being easy on the yarder and ropes (Table 1).

Table 1: Advantages of North Bend Skyline

Response	No.
Bridling capability/Lateral yarding/Versatility	18
Increased lift/Less soil disturbance	18
Productivity/Good payloads	13
Robust/Hard to break/Easy on machine/ropes	8
Easy setup and rope shifts/Simple to operate	7
Good control over drag/Gets over obstacles	6
Less power required	2
Lower fuel consumption	2
Good for long distances	2

Practical working distance is 400-450m when suitable deflection is available.

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There were also perceived disadvantages, and they included longer setup time as well as longer and more complicated line shifts. Although some noted that the system was productive others stated the temptation to bridle too far often resulted in lower production and higher operating costs. There were also differing opinions as to whether or not drag control was good or bad with North Bend (Table 2).

Table 2: Disadvantages associated with North Bend

Response	No.
Longer skyline shifts/Tempted to bridle too far	9
Longer setup/Higher cost of operation	8
Low production	7
Walk in & out for breaker outs	4
Hard to control rigging for hook-up	4
Lack of suspension/Less control over drag / Breakage	4
Overloading hazard/Pulling out stumps	4
Skill required to operate	3
Rope wear	3
Long distance yarding	3
Blind leads/Deep gulleys	3
High fuel use	2
Landing and unhooking	2
Rider block / fall block hitting together	2

Scab or Running Skyline (Grabinski)

The Grabinski system uses a rider block running on the tail rope to create a running skyline or, as it is commonly called in New Zealand, Scab Skyline (or "Scabbing"). In terms of recent use (over the last 5 years) Scab Skyline was the most commonly used of all rigging configurations in the survey. Many preferred this because like Highleading it is simple to setup and run (requiring only a 2-drum hauler).

Table 3 summarises some of the advantages including the ability to make quick line shifts especially when using a mobile tailhold, and it provides more lift than Highlead logging.

Table 3: Advantages associated with Scab or Running Skyline.

Response	No.
Simple/Quick setup & easy line shifts	21
Productive/Quick	15
Simple to operate/less skill required	12
Less ground disturbance/More lift than Highlead	9
Minimal deflection required/Good for short haul distances	5
Easy to get slack in rope/Easy to land gear	3
Gear elevated off ground/Less rope wear	3
Can downhill yard	2
Less power required/More pulling force	2
More control over drag	2
Less expensive yarder required	2

Although Scabbing is relatively simple with quick setup and line shifts, concerns were expressed with the configuration's payload capacity, and functional problems with gear such as line wrapping, rope wear, and brake wear also surfaced as potential drawbacks to the system. Although it has improved lift over Highlead, it still has little lift compared to a live skyline system and often cannot minimise soil disturbance or suit all terrain conditions. This is probably why there were many conflicting responses to issues like rope wear, ground disturbance, and productivity (Table 4).

Table 4: Disadvantages associated with Scab or Running Skyline.

Response	No.
Rope wear & tangle/Gear breakage	12
Brake wear/Pulling against Tail rope	10
Short haul distances/Terrain limited	8
Lack of lift/needs good deflection or tall tower	8
Low productivity/small payloads/More power required	7
Higher fuel consumption	5
Soil disturbance	4
Lots of line shifts/Line shift time without mobile tail	3
Drag gravitation on side slopes	2
No lateral yarding	2

Shotgun (or Gravity Return)

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Shotgun is a simple two-rope system for uphill yarding using a skyline and a mainline. No tail rope is required as the carriage is returned downhill by gravity. With a 2-drum hauler the main rope is used as a live skyline and the tail rope as a main rope. Unlike Highleading the Shotgun system will not work on flat ground or where there is limited deflection.

In this survey, the live skyline with a Shotgun carriage was another popular configuration used often in the last 5 years. This configuration was highly regarded by users as the cheapest configuration to run due to its low fuel use. It is also very simple to operate and set up, and highly productive since it tends to maximize payloads. It has good suspension of logs which often makes it a useful choice to fly logs over creeks or around obstacles (Table 5).

Table 5: Advantages associated with Shotgun.

Response	No.
Maximizes deflection & payloads/Full suspension	17
Fuel use/Cheap to run	15
Productivity/Quick	10
Easy setup/Simple to operate	6
Less power required	3
Easy on breaker outs/Easy to land logs and drop gear	3
Less rope/Gear wear	2

Table 6: Disadvantages of Shotgunning.

Response	#
Limited to terrain/Can't do back face without slackline (tail rope)	8
Brake, rope, & gear wear	5
Complicated/More difficult line shifts	5
Productivity	4
Overloading hazard/Need good communication with breaker outs	4
Lack of deflection/Soil disturbance	3
Hard to get caught drags unstuck	3
No lateral yarding	2
Need good anchors	2

While cheaper to run in terms of fuel, some of the disadvantages stated with this configuration were expensive maintenance due to brake, rope, and gear wear. The configuration is also limited to terrain where there is a steep enough chord slope for gravity to return the carriage quickly. Although the concept is simple there is a hazard of overloading the skyline, and therefore operators need to have good communication and breaker outs need to be well trained (Table 6).

Highlead

Highlead is one of the oldest systems and is effectively ground hauling using a 2-drum hauler (main rope and tail rope). Useful haul distance is commonly recognised as 250 metres. The system is best for uphill logging and is virtually unusable for downhill extraction as there is no lift over obstacles.

Table 7: Advantages associated with Highlead.

Response	No.
Quick to setup/Simple to operate	18
Good when there is limited deflection	14
Good for short hauling distances	8
Good last resort when nothing else works	6
Easy line shifts/No skyline	6
Productive system	5
Ability to extract from blind areas	4
Cheap to run/Less expensive yarder	4
Less force on anchors	2
Good for two staging	1

The most common advantages of Highleading are its simplicity in operation and setup, and its ability to function when there is limited deflection which prohibits most other configurations from being used (Table 7).

Despite the advantages, the lack of lift with Highleading poses a problem with a high level of ground disturbance, breakage of stems, rope and rigging wear, and low productivity (Table 8).

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Table 8: Disadvantages of Highleading.

Response	#
Lack of lift/Rigging drags on ground	24
Ground disturbance	14
Little control / Drags get stuck / Breakage	14
Slow / low productivity / Small payloads	11
Rope wear	8
Rigging / Chains tangle	6
Hard on breaker-outs / Hazardous	4
High fuel use	3
Loss of power due to braking tail rope	3
Limited to short haul distance / terrain	2
Difficult manual line shifts	1
Need long chokers	1

CONCLUSION

The first part of this project has provided information about current usage of different cable rigging configurations. It is clear from the results that some rigging configurations such as North Bend, Scabbing, Shotgun and Highlead are well known and used. However, knowledge of other rigging configurations and equipment options such as grapples, and mechanical or motorised carriages was limited.

A lot of comments were collected about perceived advantages and disadvantages of the various configurations. However in some cases contradicting opinions indicated the opportunity for additional resources and training to be developed.

In the next phase of this project an expert group is used to synthesize the responses. The goal is to develop a rigging guide that will help company planners and cable yarding contractors make informed decisions about the best rigging configuration option for the operating conditions.

Acknowledgements

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