

## Extended Abstract

### Successful training strategies for introducing cable yarding technologies in China

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Within the Sino-German research project Lin2Value the development, implementation and scientific monitoring of a semi-mechanized harvesting system with cable yarder extraction was conducted in close cooperation with the *Experimental Center of Tropical Forestry (ECTF)* in Pingxiang/Guangxi province, China. For the intended transition of China's forestry to multi-purpose forest management the traditional clear-cut system for the production of mainly small dimensional timber is partly progressing to single tree harvest of valuable, large dimensional timber for higher value products. Together with the Austrian cable yarder manufacturer *KOLLER Co.*, the internationally proven K303H was introduced to Pingxiang in October 2013. Its comparatively simple handling and low maintenance requirements suits the introduction of yarding techniques to new users very well. However, the inexperience of the center's personnel in modern harvesting systems and overall operational planning required an intensive educational training from the very start, following the long-term goal to establish a demonstration center for cable yarding at the ECTF. Also in fall 2013, the *Guangxi Lee & Man Forestry Technology Limited (GLMF)* started the implementation with related training of a running skyline system in Western Guangxi. This system utilizes an IGLAND 4000/2 winch as the base for a purpose build skyline hauler. Its main area of application is the harvest of short-rotation and high-yielding Eucalyptus plantations in Guangxi in clear cut operations. The goal of the study was to analyze and evaluate both training approaches to identify opportunities and challenges for future training programs.

#### Training set up

The first training at *ECTF* was conducted in October 2013 launched with an intensive one-week course in the basics of forest operations, occupational safety, operational planning, cable yarding technologies and principles especially suited for the work with K303H. Parallel, in cooperation with a professional chain saw instructor of *Guangxi Stora Enso Forestry Co Ltd.*, a two weeks lasting theoretical and practical training in directional felling and first aid as a crucial part of cable yarding operations was given to a set of people intended to be employed as chain saw workers, excluding the later yarder crew. The positions of the members in the yarding crew were chosen based on each individual's preference and former experience in forestry or related fields, which stayed fixed throughout the training period. After the theoretical introduction a two-week practical training together with a highly experienced instructor from the yarder manufacturing company *KOLLER* was held covering the assembly, maintenance, corridor set-up and uphill yarding operation. In March 2014 a second training was conducted covering the review of the gained knowledge together with additional practical training for downhill yarding operation, within single-tree and clear-cut operations.

In contrast, the training period of *GLMF* consisted of nine days of chainsaw operation and maintenance, guided by a professional STIHL chainsaw instructor from overseas. This was followed by a non-contiguous period of 32 days in basic operational planning, occupational health and safety, machine and winch set-up, maintenance and operation, which was guided by two professional instructors from New Zealand, both having several years of work experience with that particular yarder model. Nearly all trainees received training in felling,

rigging, line planning, operation and hazard identification giving the option of each crew member being able to take on any operation related task. All steps of the instructions were recorded in a notebook and additionally with video cameras at the *ECTF* training, in order to regularly monitor and review the training status of the crew, develop a code of practice and give suggestions for improvement. Subsequent to both trainings, time and productivity studies were conducted to monitor changes in productivity and to identify shortfalls of the operational planning. *GLMF* divided their training into different phases, using each stage as a learning process to improve the following stages and identify suitable approaches for training. Up to now the *ECTF* did not plan follow-up trainings of new crew members, but will rather focus on gaining experience in operating the system with a set crew.

**Table 1:** Training conditions of both cable yarding operations.

	<b>Experimental Center for Tropical Forestry</b>	<b>Guangxi Lee &amp; Man Forestry Technology Ltd</b>
<b>Type of organization</b>	Governmental research center	Private forest company
<b>Harvesting scheme</b>	Single-tree and periodic thinning	Clear-cut
<b>Harvesting system</b>	Manual felling using chain saw	Manual felling using chain saw
<b>Extraction</b>	KOLLER K303H; Standing skyline cable yarder, slack-pulling carriage	IGLAND Hauler 4000/2; Running and standing skyline cable yarder, non-slack-pulling carriage
<b>Main aim of training</b>	Establishment of cable yarding demonstration center in SE-China	Development of future logging contractors running their own crews
<b>Duration of training</b>	5 days theoretical training, 12 days chainsaw training, 23 days practical yarding training	9 days chainsaw training, 32 days practical yarding training
<b>Crew size</b>	8 (excl.fellers)	8
<b>Crew age &amp; background</b>	26-48 years, mainly vocational training not related to forestry	
<b>Constraints prior to training</b>	New and inexperienced users in forestry Limited understanding of forest operations and planning Need for improved occupational health & safety Poor forest operations infrastructure/contractor situation Distinct rainy season preventing operations Research organization aiming at a commercial operation Daily rated chainsaw workers Budget limitations for training	

## Review

By comparing the two training strategies immanent differences in the approach of training method can be identified. Whereas *GLMF* solely focusses on the practical development of a very skilled and manifold trained workforce – with the potential option of every trained crew member becoming an operational manager of its own crew – *ECTF* bases it's training on a more advanced and operationally demanding technique, considering its role as future demonstration center for newly developed silvicultural and harvesting systems to meet future sustainable forest management goals. Our review of the two training concepts resulted in the following key findings and recommendations:

**Efficient training can only be assured with the involvement of highly experienced instructors and sufficient time spent with training, whereas safety training should not be traded off with practical training of yarder operation** - Due to time and budget constraints, the *ECTF* operation only allowed for two trainings of two weeks during each period. However, a period of four weeks was suggested by the trainer, which would have allowed him to advise the different crew members during their work processes enhancing their confidence. During the time between the two trainings the crew at *ECTF* was working without guidance from outside at low productivity. Within 3½ months only 102 productive machine hours could be reached limiting the effect of training.

**Special attention should be paid to the education of Operation Managers, educating in operational planning, crew management and machine costs** - A major constraint identified in the operation of *ECTF* has been the unclear assignment of responsibilities. Although Operation Managers have been assigned, their knowledge of the operation is limited, as they themselves did rarely take part in the practical training of yarder operation or choker setting. Operation Managers need to have specific knowledge of all processes of an operation to be able to plan ahead and execute the harvesting plan. They are the binding link to ensure a sustainable and productive operation and training should especially focus on enhancing their competencies. Operation planning and work site organization has been identified as a major constraint at both operations.

**Focus of training should be put on young and motivated people with a permanent contract and realized deficits of performance during the operation need to be addressed at an early stage by additional training or replacing of personnel** - To avoid problems at a later stage, a thorough selection of talented, skilled, motivated and fit yarder operating personnel is essential in the beginning of forming the crews. So far no rewards of individual and group performance have been introduced to each of the two operations, which could increase motivation and improve productivity.

**Professional and efficient (sustainable and cost effective) work as a forestry contractor is only possible with well equipped, trained and permanent employed workers which identify themselves with the team and the task to fulfil** - Currently chainsaw workers at the *ECTF* are solely employed on a daily rated basis, without a long-term contract or social benefits. Although being more flexible in the work organization by hiring workers on a daily basis, skilled chainsaw workers are crucial for the success of a cable yarding operation. During both trainings different chainsaw workers were hired, some of them not trained in directional felling, causing idle time of the yarder and also delays in the implementation of the training schedule with the international trainer. To ensure an efficient yarding operation, chainsaw workers need to be involved into the yarding training and should preferably be physical fit and of young age.

Garland (2001) estimates that only 50 percent of the machines work pace and loadings potential is being utilized in common cable yarding operations, given that 40-50 percent of the productive cycle time is being shared by human-controlled activities. Several authors have shown that the investment in professional cable yarding training is essential for the development of safety awareness, long-lasting skills and a direct increase in productivity, quality and efficiency (e.g. Aalmo, 2014; Haynes, 2001). As shown by Cavalli (2012) the research activities on cable yarding education and training in the recent years have been scarce, rather focusing on the efficiency and technological improvements of yarding operations. The successful introduction of advanced harvesting and yarding technology into Chinese forestry will strongly rely on well adapted and organized training programs which include all people relevant for the operation in a multi-phase training process.

## References

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