Understanding Complexity- Moving from Theory to Concepts and Tools

US Forest Service Guide for Chain Saw and Crosscut Saw Use

Complexity is a characterization of the saw operation that determines the level of skill, experience and sawyer certification needed based on numerous static and dynamic factors that will affect the saw operation. This guide provides information about planning a saw operation, identifies general divisions between low and high complexity and finally, introduces a field tool that uses the OHLEC mnemonic as a cue to help identify thresholds within each step of the saw operation. It will serve as a common reference for the development of additional curricula and field tools for instruction, evaluation and operation.

The agency recognizes every tree and situation is unique and requires the sawyer to make an informed judgment and use techniques learned during training to safely conduct saw operations. The theory, concept and tools presented in this guide were designed to provide the information necessary for a sawyer to think through the cutting process and resolve complexities with the result being a safe and efficient operation.

The following sections, *Understanding Operational Complexity*, *Comparison of Low Complexity and High Complexity Trees* and the *Chain Saw/Crosscut Saw and Axe Complexity Field Guides* will help sawyers understand the theory, concept and application of complexity as it relates to size up and cutting processes.

Understanding Operational Complexity

The complexity of a saw operation is dependent on four components:

- Objective-The operation to be completed
  - Felling
  - Bucking
  - Limbing/brushing
- Environment-The dynamic conditions of the environment
  - Wind
  - Topography
  - Rain or snow
- Sawyer-The dynamic state of mind and ability of the sawyer
  - Training
  - Experience
  - State of mind
  - Attitude
  - Pressure
  - Unfamiliar equipment
- Fiber-The static condition/attitude of the wood itself
  - Sound or rotten
  - Fire weakened
  - Lean or bind
  - Frozen

At the time of the operation two components, the objective and the condition of the fiber/wood, will remain essentially static once size up is complete and the complexity is determined. The physical environment and the sawyer themselves have a dynamic influence on the overall complexity given changes from one minute to the next.

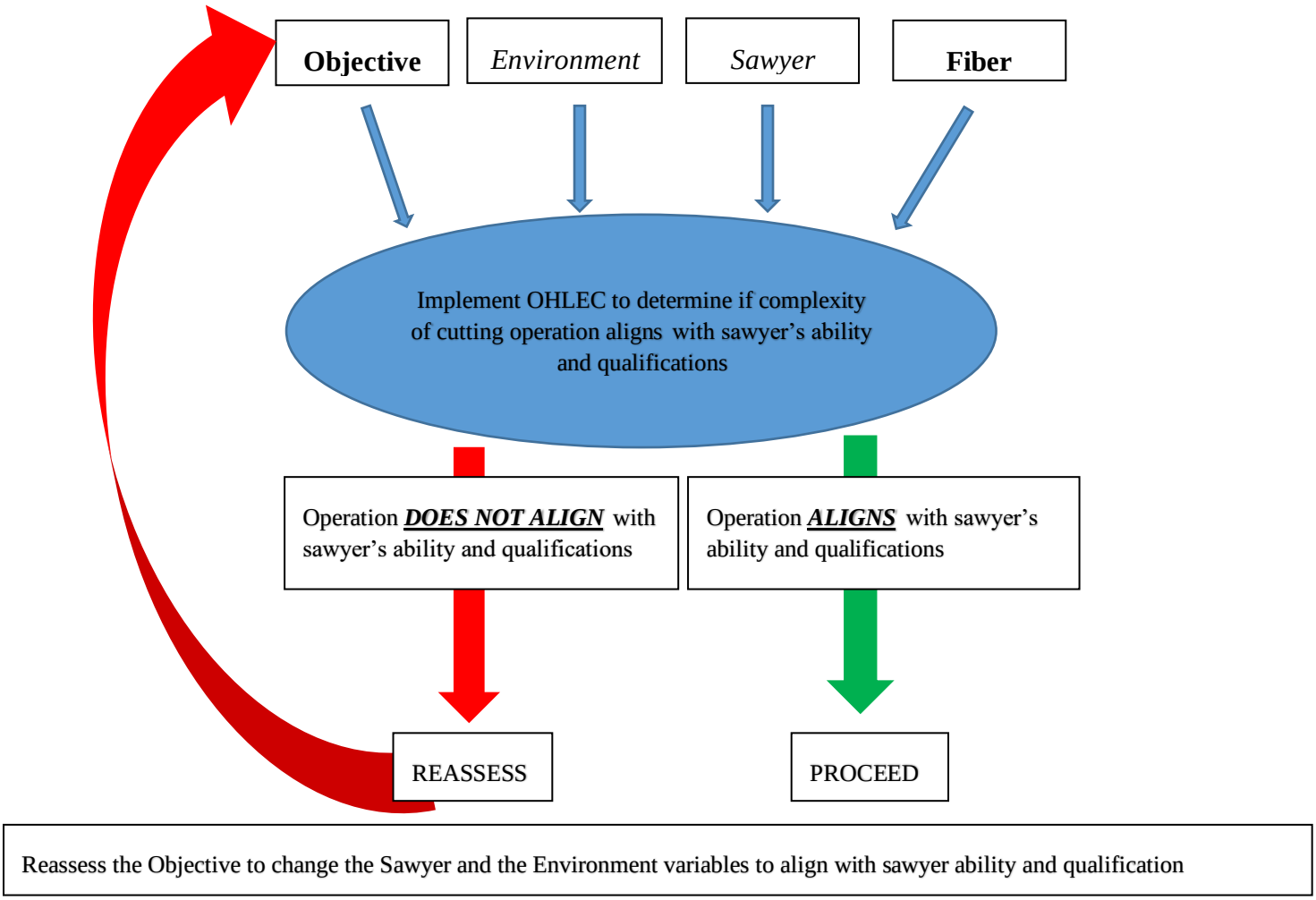

Figure 1-Operational Complexity Decision Tree

Comparison of Low Complexity and High Complexity Trees

Trees can be generally categorized into three levels of complexity; Low, Medium and High. For the purpose of simplicity the following table identifies Low Complexity and High Complexity Conditions. Therefore, any conditions that exceed Low but do not meet High are considered Medium.

LOW COMPLEXITY *Contains ALL of the Following Conditions*	**HIGH COMPLEXITY** *ANY of the Following Conditions*
A tree that is green or recently dead	DBH >1.5 x bar length
Tree Is NOT on fire	A snag containing fire >10' above the sawyer's head
Hazards are minimal, static, understood and stable	Any tree containing active fire in any part of the bole that consumed >25% of diameter or is embedded in the tree
Is free of any back lean and has less than 5' of head or side lean	Requires >2" of lift to overcome back lean
Bole of tree is >80% sound	Hazards are numerous, dynamic, not understood and/or unstable

Figure 2-Low and High Complexity Tree Indicators

Chain Saw/Crosscut Saw and Axe Complexity Field Guides

The following two tables provide conditional parameters that the sawyer can use during the planning phase of the saw operation and is guided by the OHLEC mnemonic. It provides more information than the table in Figure 2 and outlines commonly encountered conditions that can be measured using techniques learned through training.

Chain Saw Complexity Field Guide		Complexity
Objective • How do I get home safely? • What needs to be done? • What is your desired lay? • What obstacles exist and are their values high?	Fall tree to any lay	**Low**
	Bucking or Limbing Only	**Low**
	Fall tree within 45 degrees of specific lay	**Moderate**
	Fall tree within 5 degrees of specific lay	**High**
	No safe lay	**STOP Reevaluate**
Hazards – Identify • Overhead hazards • Other Tree hazards in cutting area • Environmental Hazards • Cutting area hazards • Wood Hazards – rot, cracks, live, dead, fire weakened • Human Factor Hazards	0-2 Individual Hazards	**Low**
	3-5 Individual Hazards	**Moderate**
	>5 Individual Hazards	**High**
	No Escape from Hazards	**STOP Reevaluate**
	<30% Fiber at Hinge	**STOP Reevaluate**
	Base won't support stem if cut	**STOP Reevaluate**
Leans (Falling) • Side to Side • Head or Back	**Side**	
	< 3 feet	**Low**
	3 ft. -5 ft.	**Moderate**
	>5 ft.	**High**
	Head	
	<3 ft.	**Low**
	>3 ft.	**Moderate**
Binds (Bucking) • Top/Bottom • Side to side • End to end • Combinations	**Back**	
	1-2" lift to overcome	**Moderate**
	>2" lift to overcome	**High**
	Binds	
	Known Low release of energy	**Low**
	Release of energy know but may require a series of cuts	**Moderate**
	High release of energy expected or unknown	**High**
Escape routes	**Angle**	

	45 degree both clear	**Low**
	Only 1 escape route	**Moderate**
	Distance	
	15ft	**Low**
	10ft-15ft	**Moderate**
	No Escape Route	**STOP Reevaluate**
Cutting Plan • Hinge design (80/10) • Undercut • Back cut • Sequence of cuts • Type of bucking cut • Slope steepness	**Undercut**	
	Single cut undercut	**Low**
	Double cut undercut	**Moderate**
	Sequence of cuts	
	All from 1 side, escape to same side	**Low**
	Requires moving from side to side of tree.	**Moderate**
	Backcut	
	Single backcut	**Low**
	Double cut backcut	**Moderate**
	Saw guts out or bore fiber from face cut	**Moderate**
	Cutting plan does not meet objective	**STOP Reevaluate**
	Cutting plan needs to be changed	**STOP Reevaluate**

Figure 3-Chain Saw Complexity Field Guide

Crosscut Saw and Axe Complexity Field Guide		Complexity
Objective – What needs to be done? What is your target?	Fall tree in any direction	**Low**
	Fall tree in specific lay	**Moderate**
	Buck small bole where piece can be easily lifted and moved.	**Low**
	Buck large bole with pre-plan of how to move piece	**Moderate**
	No safe lay	**STOP Reevaluate**
Hazards – Identify • Overhead hazards • Other Tree hazards in cutting area • Environmental Hazards • Cutting area hazards • Wood Hazards – rot, cracks, live, dead, • Human Factor Hazards • Leaners and jack straws	0-2 Individual Hazards	**Low**
	3-5 Individual Hazards	**Moderate**
	>5 Individual Hazards	**High**
	No Escape from Hazards	**STOP Reevaluate**
	<30% Fiber at Hinge	**STOP Reevaluate**
	Base won't suporrt stem if cut	**STOP Reevaluate**
Leans (Falling) • Side to Side • Head or Back • Risk of barber chair	**Side**	
	< 3 feet	**Low**
	3 ft -5 ft	**Moderate**
	>5 ft	**High**
	Head	
	<3 ft	**Low**
	3ft-6ft	**Moderate**
Binds (Bucking) • Top/Bottom • Side to side • End to end • Combinations	>6 ft	**High**
	Back	
	<1" lift to overcome	**Moderate**
	>1" lift to overcome	**High**
	Back lean on tree <12" DBH	**High**
	Binds	
	Known Low release of energy	**Low**
	Release of energy know but may require a series of cuts	**Moderate**
	High release of energy expected or unknown	**High**

Escape routes	**Angle**	
	45 degree both clear	**Low**
	Only 1 escape route	**High**
	Distance	
	15ft	**Low**
	10ft-15ft	**Moderate**
	No Escape Route	**STOP Reevaluate**
Cutting Plan • Hinge design (80/10) • Undercut • Back cut • Type and sequence of cuts • Wedging Plan • Chopping	**Undercut/Hinge**	
	Conventional undercut	**Low**
	DBH > 50% of saw length	**Moderate**
	Undercut-other	**High**
	Weak side vertical chopping	**Moderate**
	Backcut	
	Double sawyer	**Low**
	Single sawyer	**Moderate**
	Bucking	
	Double sawyer	**Low**
	Single sawyer - underbucking	**Moderate**
	Cutting height above shoulders	**High**
	Cutting plan does not meet objective	**STOP Reevaluate**
	Cutting plan nees to be changed	**STOP Reevaluate**

Figure 4-Crosscut Saw and Axe Complexity Field Guide