Developing GIS Software to Process Photogrammetric Point Cloud Data for Inventory Production

Kevin Lim, Ph.D.

**President and CTO**

Lim Geomatics Inc.

343 Preston Street, Floor 11, Ottawa, ON, K1S 1N4

Enhanced Forest Resources Inventory (eFRI), Knowledge Transfer and Tool Development (KTTD) Symposium, Valhalla Inn, Thunder Bay, ON, Nov. 1-2, 2017

Presentation Outline

- Corporate Profile
- Background
- Project
  - Objective
  - Benefits
  - Partners
  - Execution and Delivery
  - Achievements and Success Stories
- Future Direction for Innovation
- Q&A

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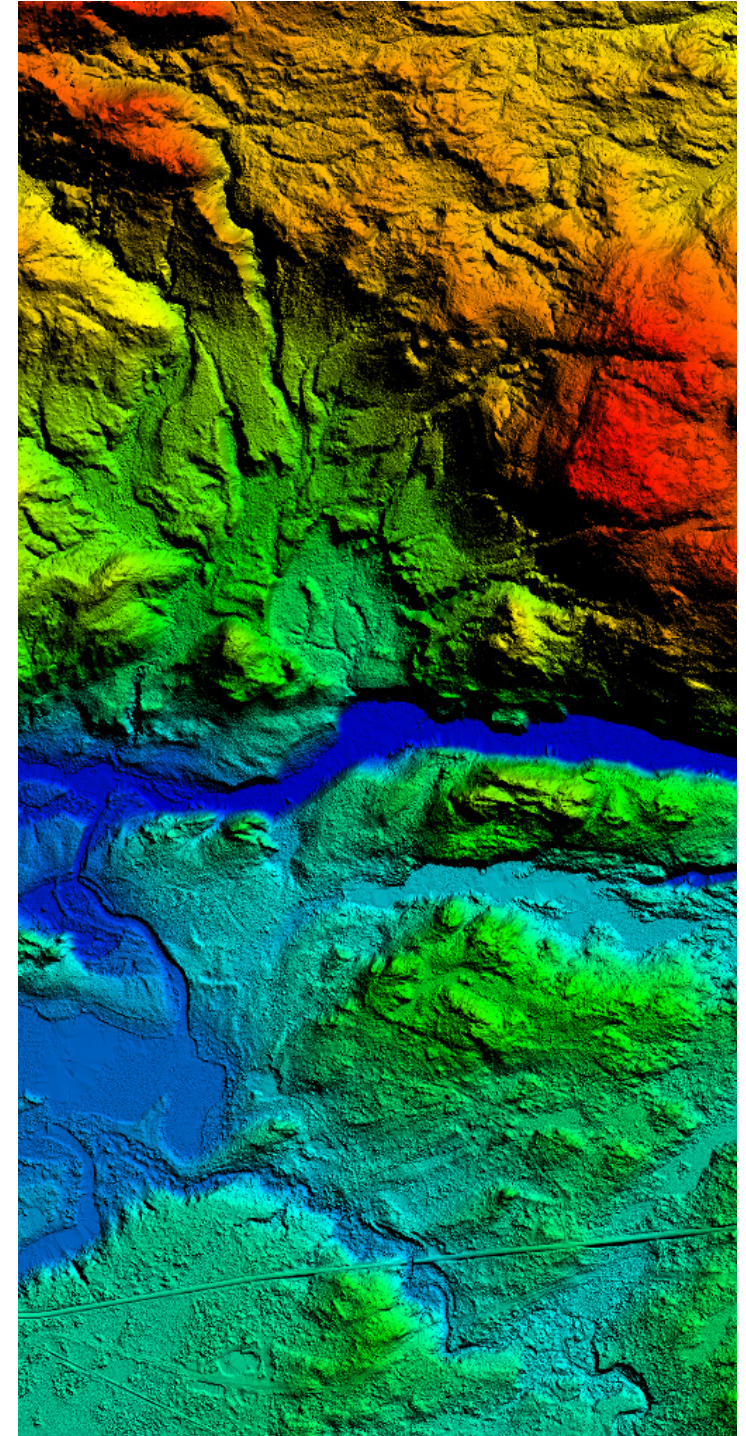
Meet the Lim Geomatics Team

President & CTO

Senior GIS Developer

Senior GIS Developer

Director of Corporate Communications

GIS Business Analyst

GIS Developer

GIS Developer
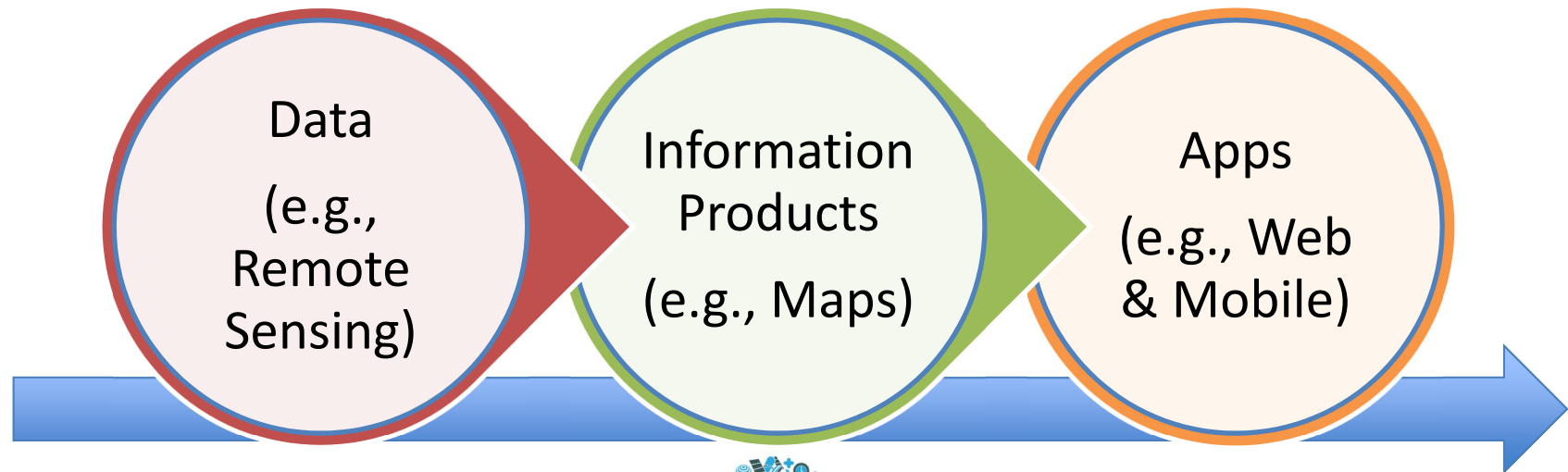
GIS Developer

Business Development Manager, Africa

GIS Team Lead

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What Does Lim Geomatics Do?

Data (e.g., Remote Sensing) → Information Products (e.g., Maps) → Apps (e.g., Web & Mobile)

amazon web services | EC2   Microsoft Azure   Google Cloud Platform   IBM Bluemix™

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Forestry Platform

Op Tracker™
for Transport

AFRIDS™

Op Tracker™

Mobile

LTK™

Arc ESRI GIS Server

Microsoft Azure

amazon web services™ EC2

ArcGIS Online
esri

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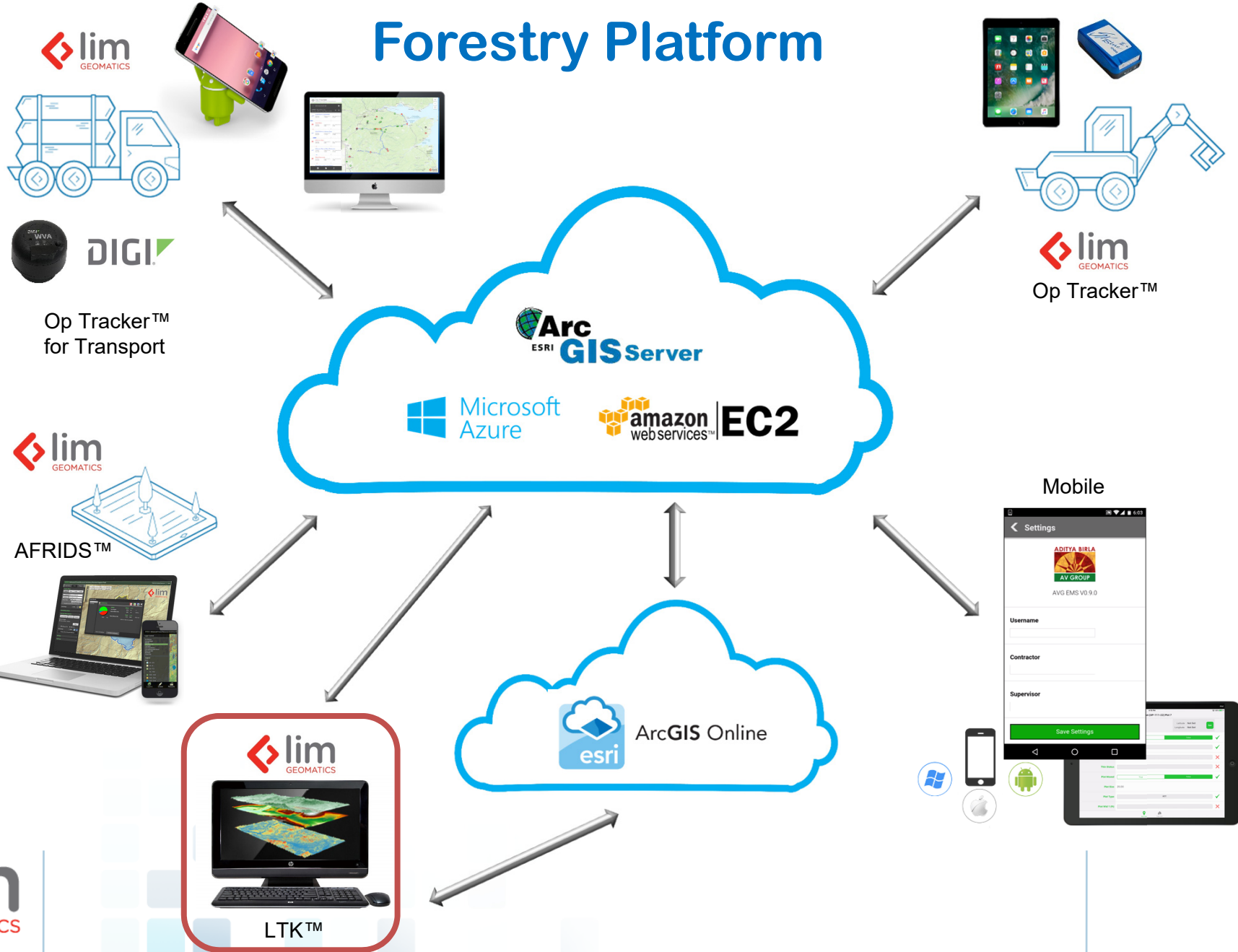
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Examples of Lim Geomatics' Forestry Clients
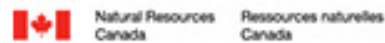
Project
Background

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Geospatially enabling businesses

Background

Previous research conducted in Ontario (Lim *et al*., 2003, Woods *et al*., 2008, Woods *et al*., 2011, Penner *et al*., 2013) has clearly demonstrated that several forest inventory variables can be predicted from airborne LiDAR data and more recently, using photogrammetric point cloud data derived from the ADS40 imagery (Pitt *et al*., 2014) that have been collected for the province in support of the last FRI update cycle. The problem today is that there is no software available to readily take a photogrammetric point cloud and process it further to a state where it can be used to generate forest inventory information products using proven workflows that were developed for LiDAR point clouds.
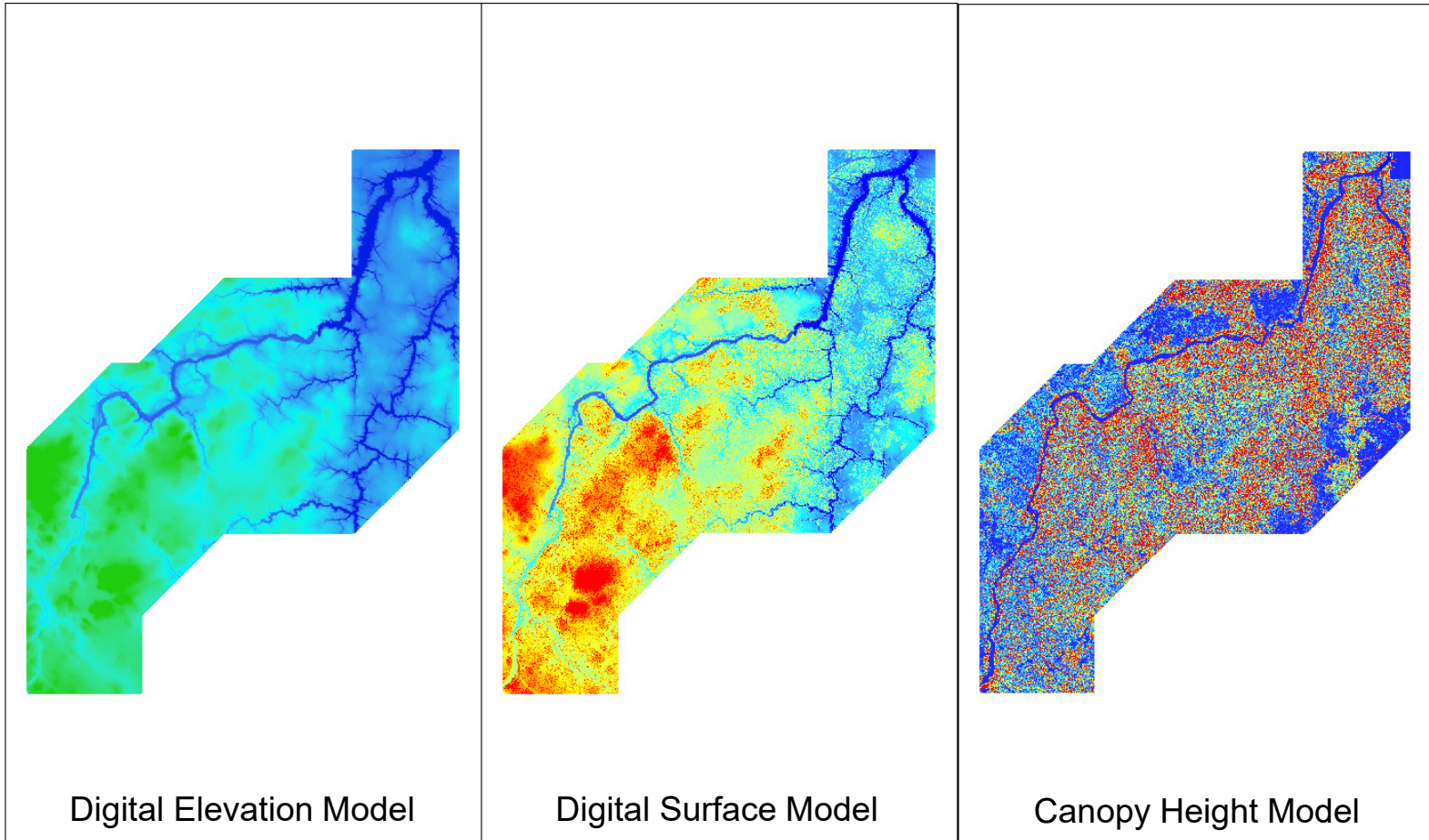
Linear Lidar 101

- Position and Orientation System (POS)
  - inertial measurement unit
- Global Positioning System (GPS)
  - airborne GPS
  - ground-based GPS
- Laser Range Finder (LRF)
  - infrared laser (e.g., 1064 nm)
  - high pulse repetition rate
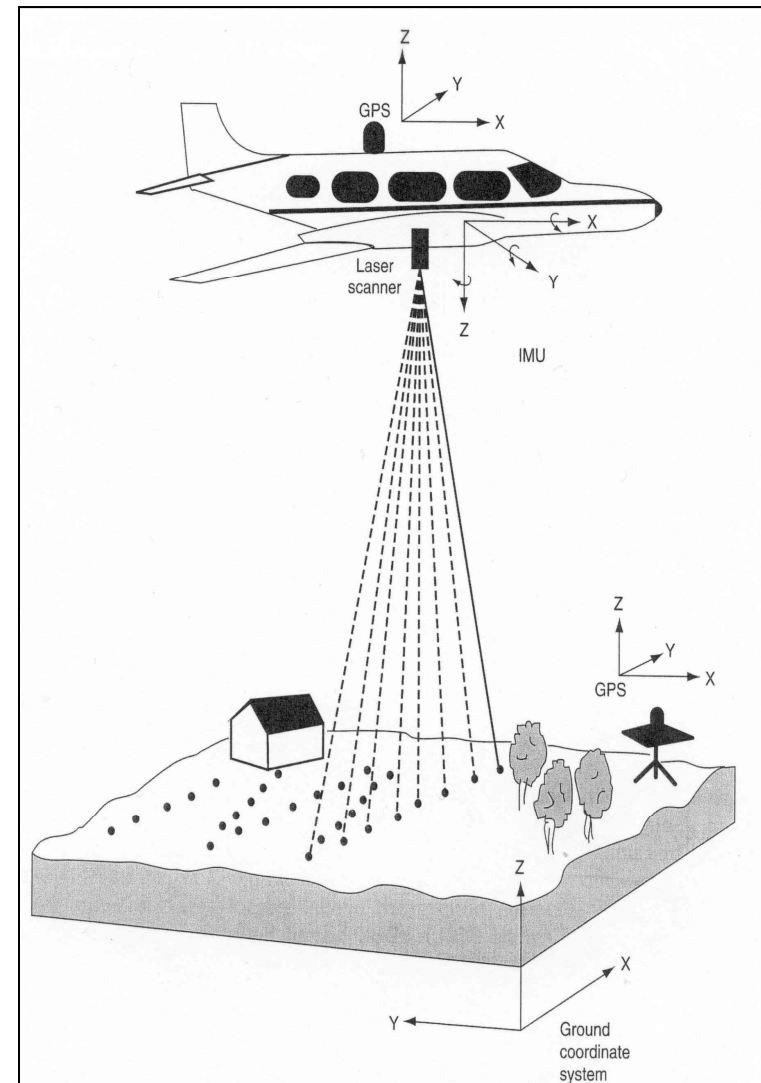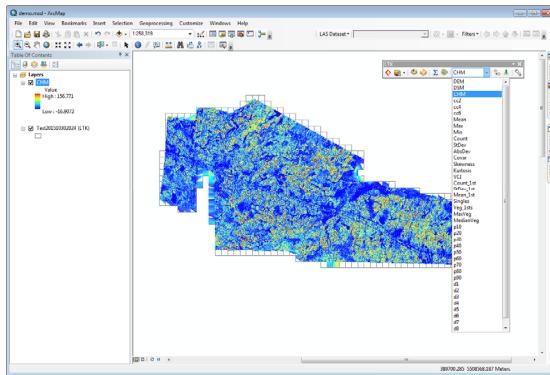

Source: Lillesand and Kiefer, 2000.

Base Elevation Products
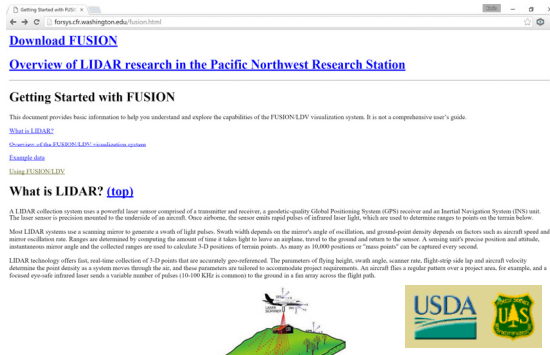

| Digital Elevation Model | Digital Surface Model | Canopy Height Model |

Software for Enhanced Forest Inventories

Forestry-Specific SW

LTK™

FUSION

Examples of General Data Processing SW
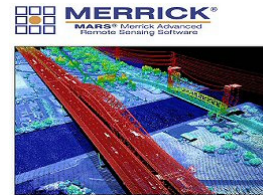
High-Level Workflow
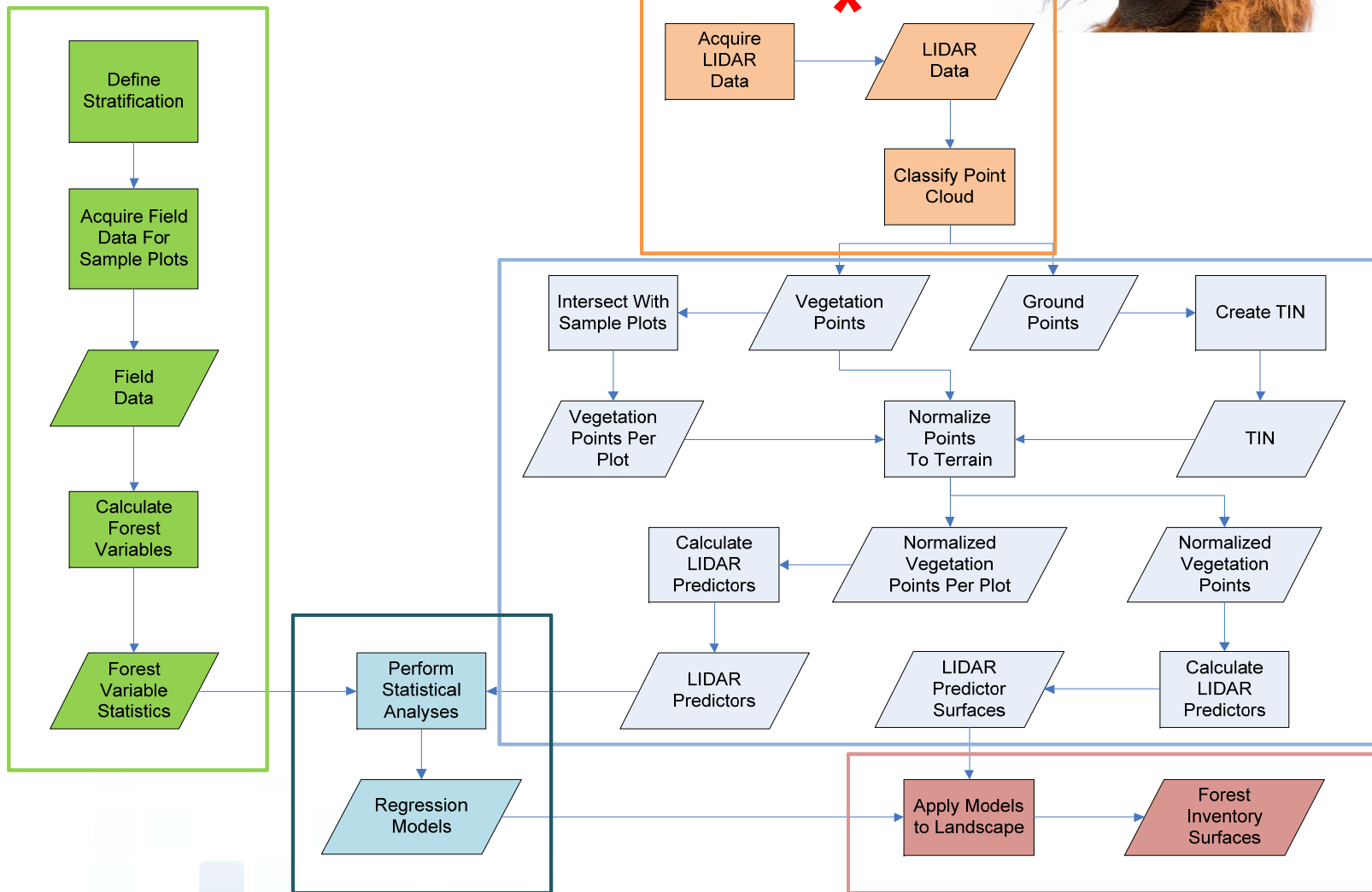
Project Objective, Benefits and Partners

Objective

To develop GIS software that will enable a user to process a photogrammetric point cloud by automating various complex data processing workflows to create spatially explicit raster surfaces of forest inventory variables, such as gross merchantable volume.

Benefits

- The target audience for the output of this project includes foresters involved with the development of strategic level inventories for provincial needs, in addition to operational ones that are more targeted towards forest industry needs.

- Forest contractors would also benefit as the developed software could be used by them to deliver enhanced forest resource inventories.

- By developing this software, imagery acquired through past and future planned provincial image acquisition programs can be leveraged to produce highly accurate and precise forest inventory information products that typically require the more expensive airborne lidar data as input.

- The proposed project will encapsulate years of point cloud research, lidar and photogrammetric expert knowledge, and workflow development and transfer it to the forestry community.

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Project Execution and Delivery

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The world has gone Agile
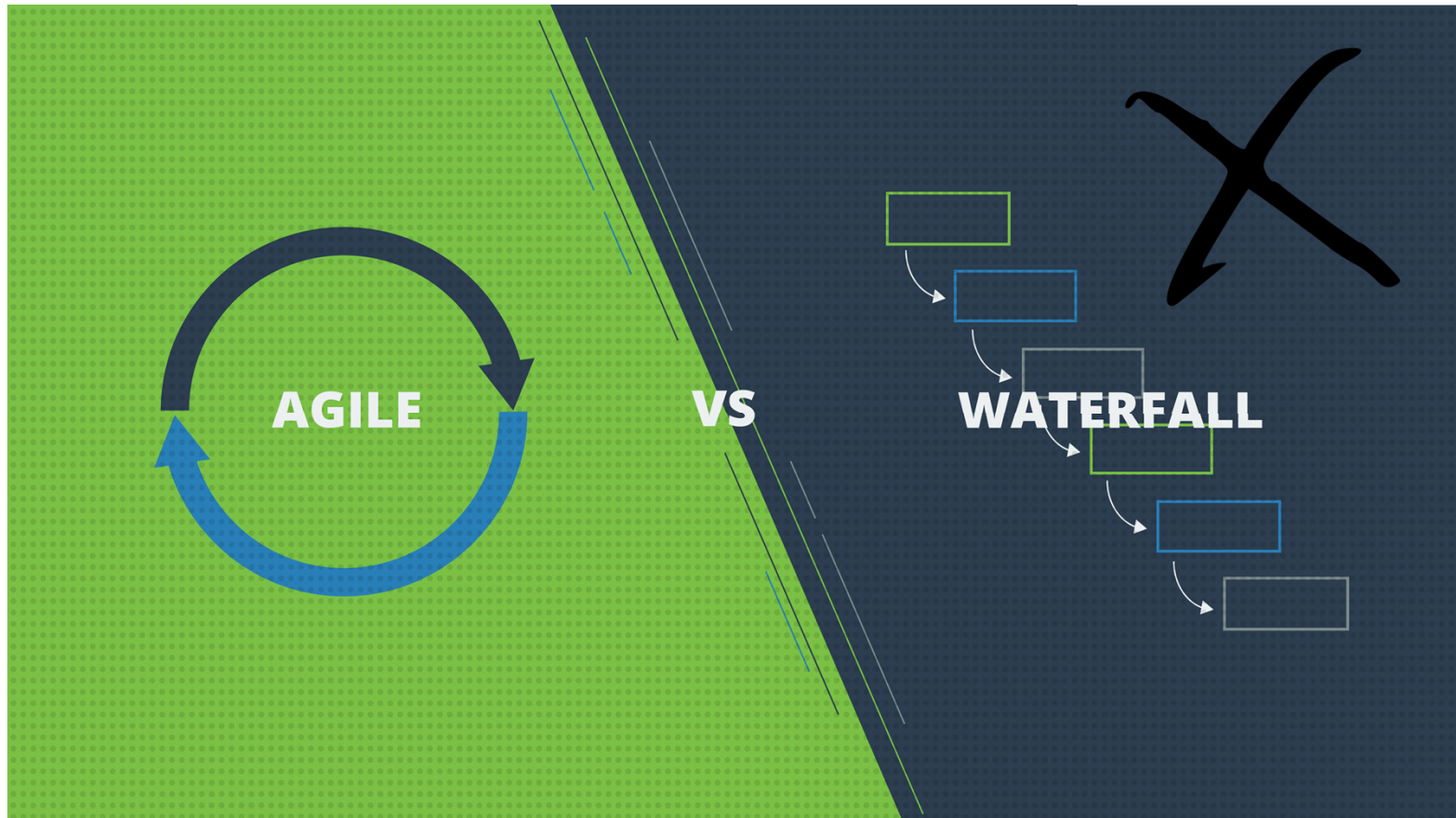
Establishing an Initial Operating Capability (IOC) + Agile (Scrum)

Agile "boiled down"…

Sprint 1

Sprint 2

Sprint 3

DESIGN

A USER INTERFACE IS LIKE A JOKE. IF YOU HAVE TO EXPLAIN IT, IT'S NOT THAT GOOD.

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LTK Version 1.2
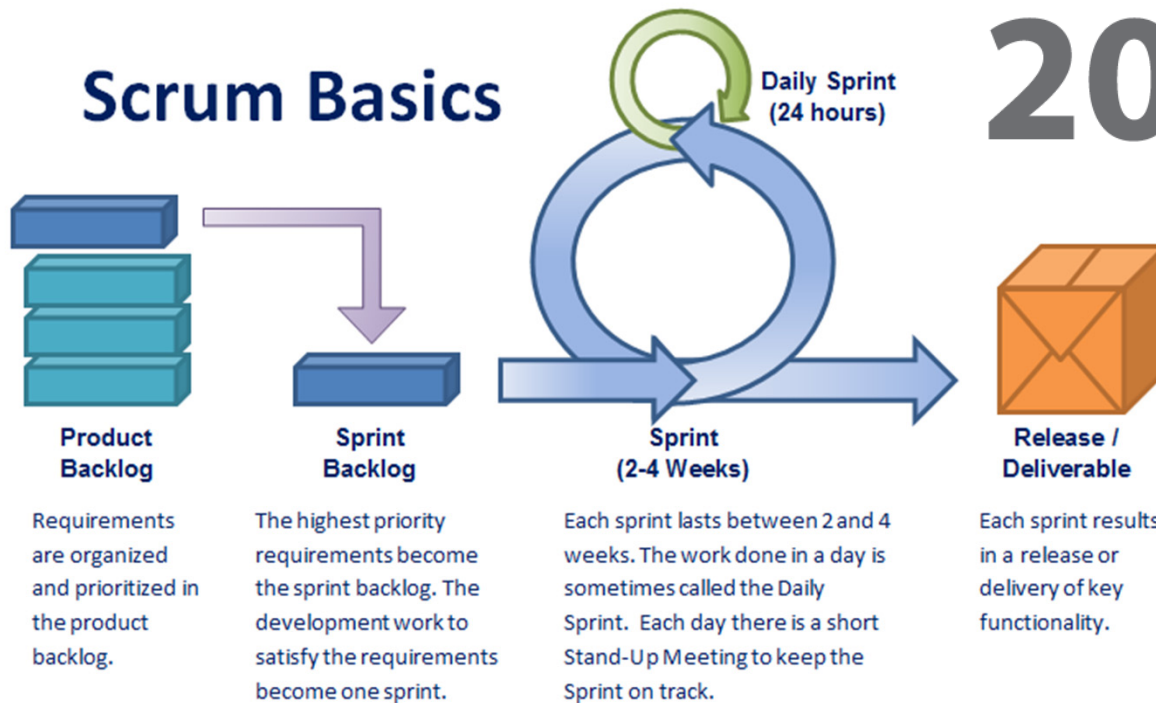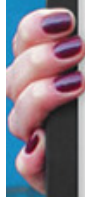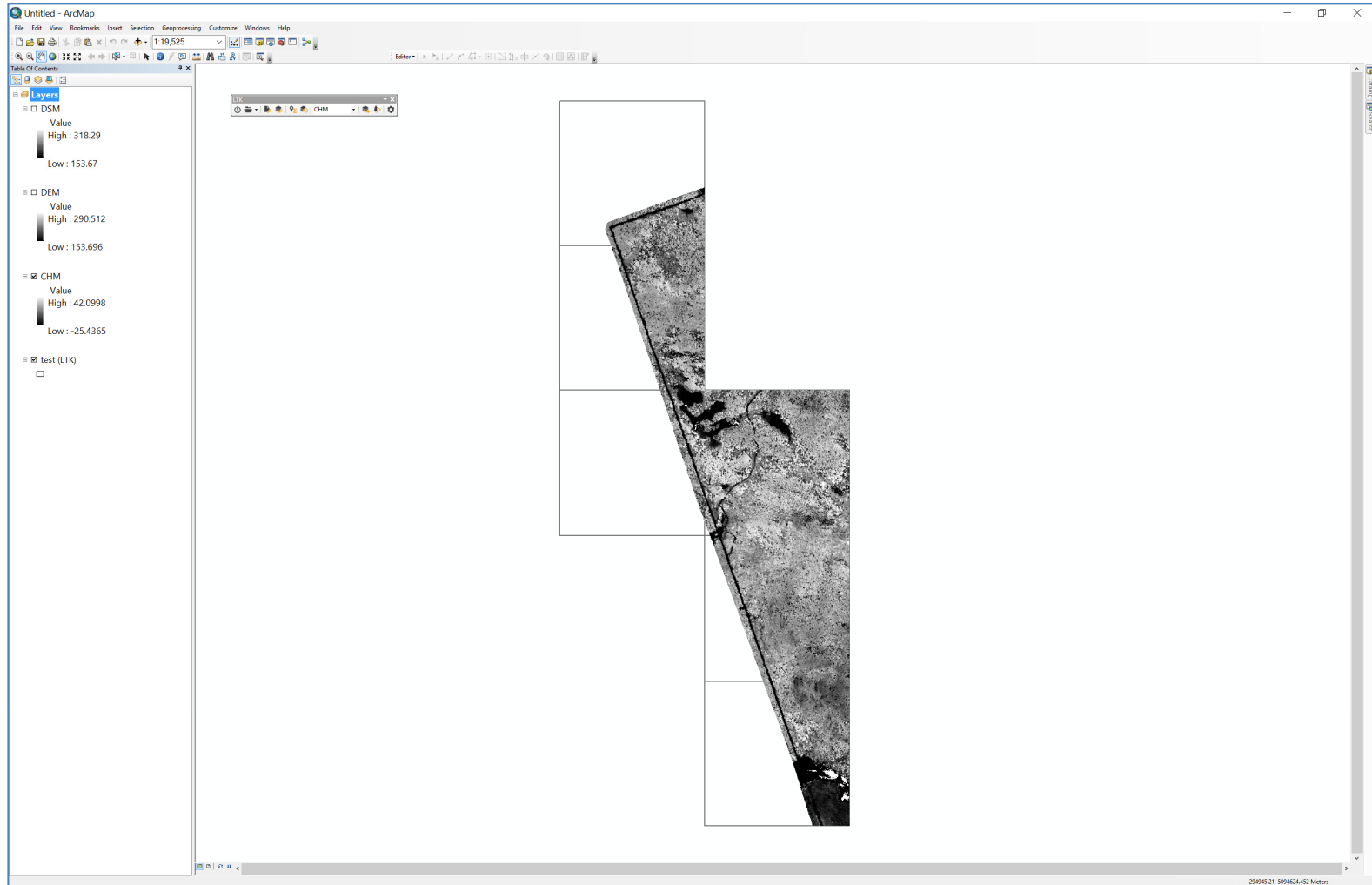
Demo of LTK™

Demo of LTK™

Achievements and Success Stories

Knowledge Transfer: Workshop

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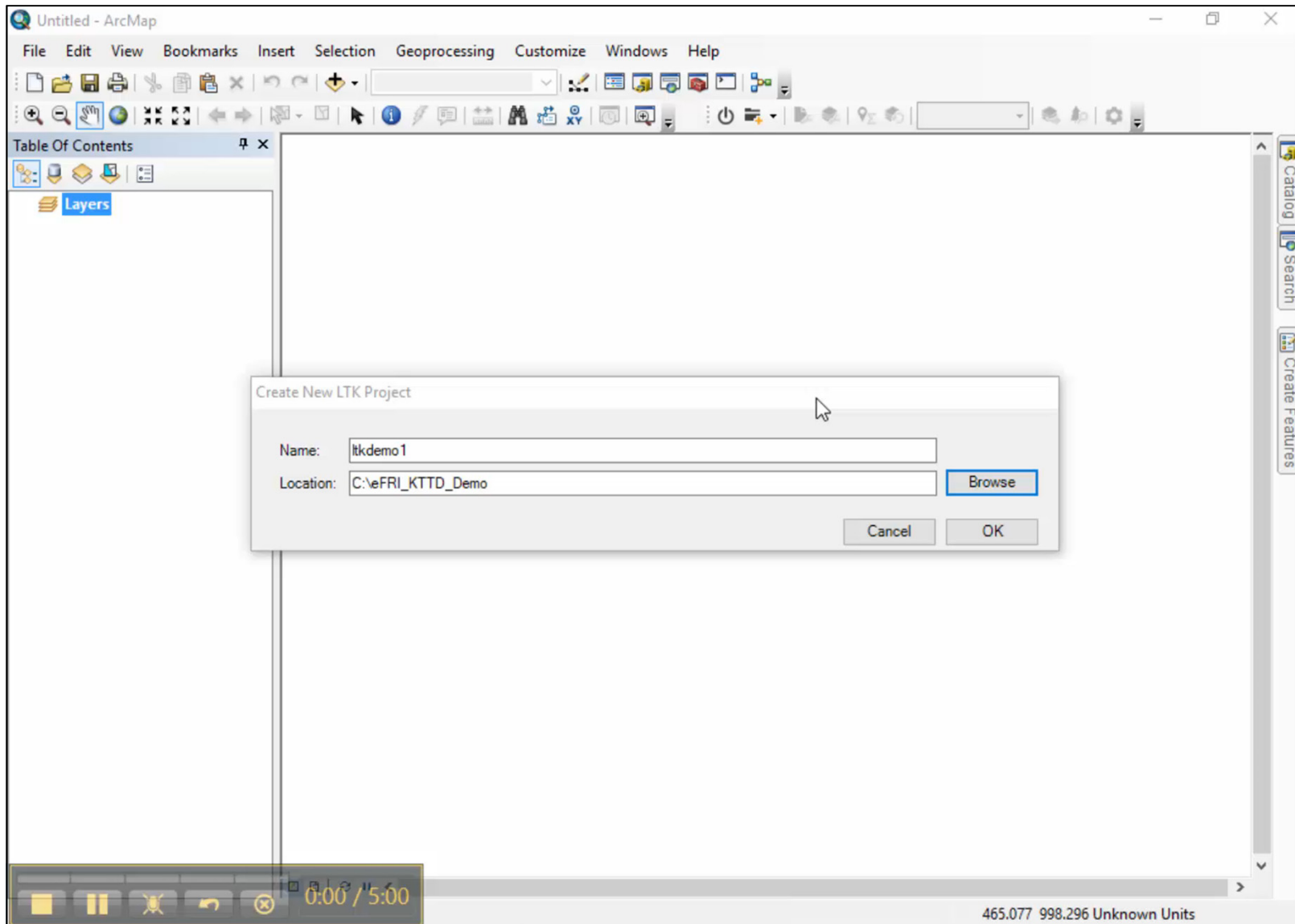
Developing Area-Based Forest Inventories Using LiDAR or Photogrammetric Point Clouds and the LTK™ Software

November 25, 2015 – 8AM to 5PM | Valhalla Inn, Thunder Bay, ON

ABOUT THE WORKSHOP

Lim Geomatics has developed the LTK™ software to facilitate the production of area-based forest inventories using LiDAR or photogrammetric point clouds within an Esri ArcGIS environment.

No need to type in command lines, instead use industry leading GIS technology to step through a series of workflows that encapsulate decades of R&D into simple user interfaces to generate spatially-explicit forest inventories from LiDAR or photogrammetric point clouds.

This one-of-a-kind workshop is not only intended to teach participants the theory behind how area-based forest inventories are created from point cloud data, but also to give them hands-on experience with creating one. The workshop will be run very much like a university lab where experts will present the theory, followed by a set of hands-on exercises.

TIME	SUBJECT	SPEAKER
07:30	Registration	
08:00	Welcome	**Dr. Kevin Lim**, President and CTO, Lim Geomatics Inc.
08:10	Opening Remarks	**Erik Wang** and **Bob Elliot**, Forestry Futures Trust Committee
08:20	Keynote	**Dr. Doug Pitt**, Research Scientist, Canadian Wood Fibre Centre, Canadian Forest Service
09:00	Overview of the LTK™ Software	**Greg McQuat**, GIS Developer, Lim Geomatics Inc.
09:15	Introduction to Point Clouds — How Did We Get Here and Lessons Learned?	**Murray Woods**, Senior Forest Analyst, Ontario Ministry of Natural Resources and Forestry
10:00	Coffee Break	
10:30	Session 1: The A to Z on Surface Models and Field Plot Design	**Murray Woods**, Senior Forest Analyst, Ontario Ministry of Natural Resources and Forestry
10:45	Hands-On 1: Creating a LTK Project and Generating DEMs, DSMs, and CHMs	**Greg McQuat**, GIS Developer, Lim Geomatics Inc.
11:30	Lunch	
	Lunchtime Address: Forests Without Borders Projects Showcase	**Breanne Neufeld**, Member, Ontario Forests Without Borders Caucus

Developing Area-Based Forest Inventories Using LiDAR or Photogrammetric Point Clouds and the LTK™ Software

13:00	Session 2: Percentiles, Return Ratios, and Canopy Density Predictors — What Does It All Mean?	**Murray Woods**, Senior Forest Analyst, Ontario Ministry of Natural Resources and Forestry
13:15	Hands-On 2: Creating Point Filters and Predictor Definitions, and Generating Predictors	**Greg McQuat**, GIS Developer, Lim Geomatics Inc.
14:00	Session 3: Statistical Modelling of Forest Inventory Variables	**Murray Woods**, Senior Forest Analyst, Ontario Ministry of Natural Resources and Forestry
14:15	Hands-On 3: Generating the Spatially-Explicit Forest Inventory	**Greg McQuat**, GIS Developer, Lim Geomatics Inc.
15:00	Coffee Break	
15:30	Hands-On 4: How-To Leverage Photo Point Clouds, Apply Advanced Predictors, and Delineate Individual Trees	**Greg McQuat**, GIS Developer, Lim Geomatics Inc.
16:00	Lim Geomatics Technology Showcase: AFRIDS™, Operational Tracker™ for Harvesters and Trucks, and MobiCruise™.	**Nick Gralewicz**, GIS Team Lead, Lim Geomatics Inc.
16:45	Closing Remarks	**Dr. Kevin Lim**, President and CTO, Lim Geomatics Inc.

WORKSHOP FEE & REGISTRATION

The registration fee for this workshop is $100 and all monies collected will be donated to Forests Without Borders.

To register for this workshop, go to: https://www.eventbrite.com/e/developing-area-based-forest-inventories-using-lidar-or-photogrammetric-point-clouds-using-the-tickets-19423027772. All registrations must be made through the Eventbrite system.

WHAT YOU WILL NEED

Participants are required to come to the workshop with their own laptop running ArcGIS Desktop 10.3.1 (Basic) with the 3-D Analyst extension. Trial versions of Esri GIS software can be requested from Esri Canada.

FOR MORE INFORMATION

For more information, please contact Dr. Kevin Lim by e-mail at: info@limgeomatics.com or by telephone at 1-800-686-8953.

ACKNOWLEDGEMENTS

FORESTRY FUTURES TRUST ONTARIO | Natural Resources Canada / Ressources naturelles Canada — Canada, Canadian Wood Fibre Centre | Canadian Institute of Forestry / Institut forestier du Canada | Ontario

www.limgeomatics.com

P.O. Box 30030 Greenbank North PO
Ottawa, Ontario, K2H 1A3
1-800-686-8953

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Knowledge Transfer: Workshop

- No. of participants: 26
  - Industry: 13
  - Government: 4
  - Academia: 2
  - Other (e.g., NGOs): 4
  - Organizers: 3
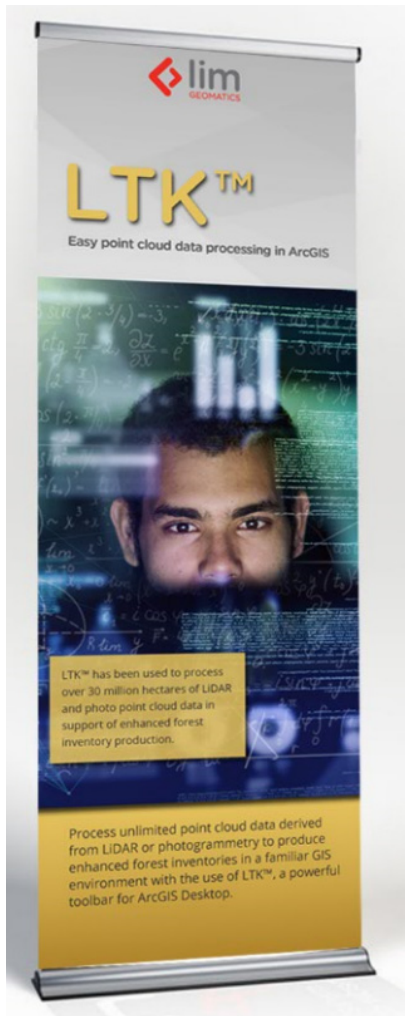

- All registration fees ($2,000) were donated to:

Forests without Borders
Forêts sans Frontières

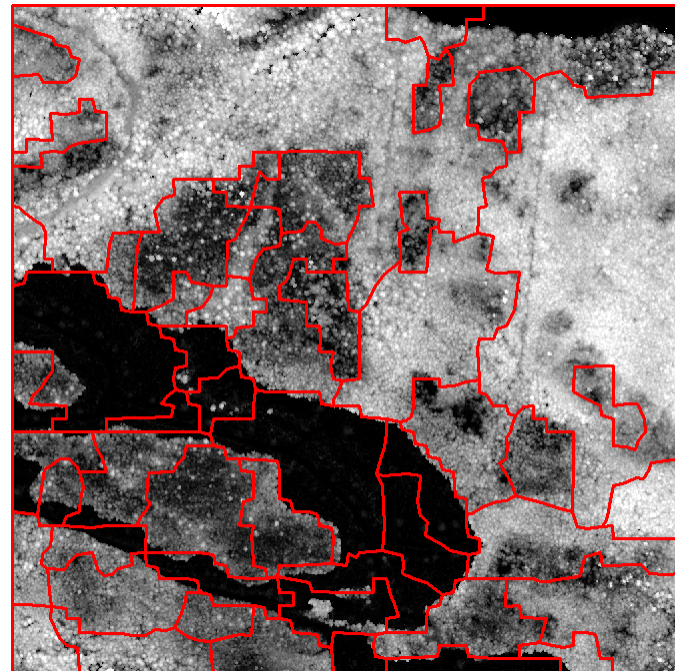# Adoption: Who is using LTK?

Public Sector

Private Sector

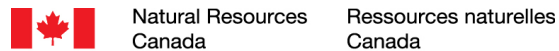# Future Direction for Innovation

- Continue Adding New Algorithms
  - Ground Classification
  - Individual Tree Extraction and Species Classification
  - Stand Auto-Generation
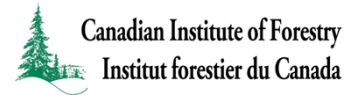- Migrate LTK to ArcGIS Pro to leverage 64-bit computing

Acknowledgements

FORESTRY FUTURES TRUST ONTARIO

tembec

Ontario
Ministry of Natural Resources

Natural Resources Canada / Ressources naturelles Canada

Canada

Canadian Institute of Forestry
Institut forestier du Canada

Canadian Wood Fibre Centre

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Lim Geomatics Inc.

343 Preston Street, Floor 11
Ottawa, Ontario, K1S 1N4, Canada

Tel.:   1-800-686-8953 ext. 700
E-mail: kevin@limgeomatics.com
Web: www.limgeomatics.com