


Innovations in Log Transportation

John Sessions


Oregon State University

A stylized silhouette of a mountain range in shades of teal, located at the bottom right of the slide.

Problem Definition

- ◆ Rising fuel costs and pollution control costs
 - ◆ Increasing road user costs
 - ◆ Fewer available trucks
- 

Opportunities

- ◆ Increase load size
 - ◆ Reduce road use costs
 - ◆ Improve truck scheduling
- 
- A stylized silhouette of a mountain range in shades of teal, located at the bottom right of the slide.

Increase Load Size

- ◆ Load size is a function of
 - tire width
 - weight per axle
 - number of axles
 - axle spacing
- ◆ Add additional axles (lift axles, trailers)
- ◆ Reduce log weight





Maximizing Load

$$\begin{aligned} \text{Max } & \sum w_i \\ & w_i \leq b_i \\ & \sum w_{dk} \leq r_k \\ & w_i \geq 0 \end{aligned}$$

w_i = loading on axle i

b_i = upper limit for axle i

d = axles in axle group k

r_k = upper limit for group k

TABLE 1. — Maximum allowable weights for vehicles operating in the State of Oregon.

Distance ^a (ft.)	2 axles	3 axles	4 axles	5 axles	6 or more axles
4	34,000				
5	34,000				
6	34,000				
7	34,000				
8	34,000				
Over 8 ft. but less than 9 ft.	34,000	42,000			
9	39,000	42,500			
10	40,000	43,500			
11	40,000	44,000			
12	40,000	45,500	50,000		
13	40,000	45,500	50,500		
14	40,000	46,500	51,500		
15	40,000	47,000	52,000		
16	40,000	48,000	52,500	52,500	
17	40,000	48,500	53,500	53,500	
18	40,000	49,500	54,000	54,000	
19	40,000	50,000	54,500	54,500	
20	40,000	51,000	55,500	55,500	
21	40,000	51,500	56,000	56,000	
22	40,000	52,500	56,500	56,500	
23	40,000	53,000	57,500	57,500	
24	40,000	54,000	58,000	58,000	
25	40,000	54,500	58,500	58,500	
26	40,000	55,500	59,500	59,500	
27	40,000	56,000	60,000	60,000	

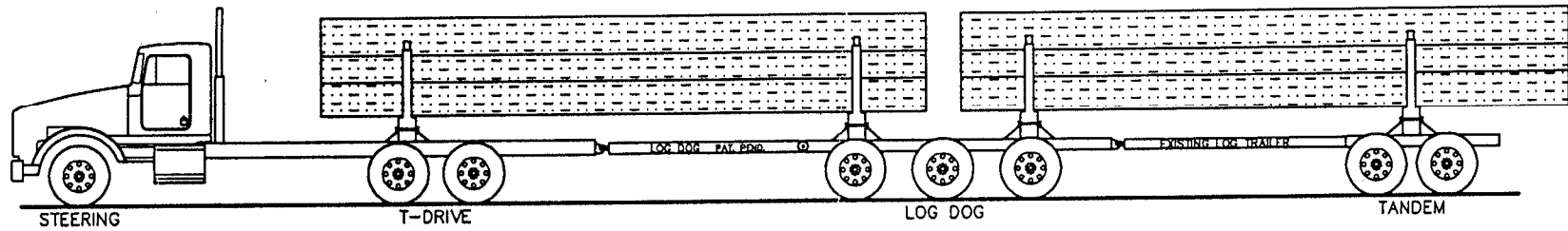
TABLE 2. — Extended maximum allowable weights for vehicles operating in the State of Oregon.^a

Axle spacing (ft.)	Maximum gross weight			
	5 axles	6 axles	7 axles	8 or more axles
			(lb.)	
47	77,500	81,000	81,000	81,000
48	78,000	82,000	82,000	82,000
49	78,500	83,000	83,000	83,000
50	79,000	84,000	84,000	84,000
51	80,000	84,500	85,000	85,000
52	80,500	85,000	86,000	86,000
53	81,000	86,000	87,000	87,000
54	81,500	86,500	88,000	91,000
55	82,500	87,000	89,000	92,000
56	83,000	87,500	90,000	93,000
57	83,500	88,000	91,000	94,000
58	84,000	89,000	92,000	95,000
59	85,000	89,500	93,000	96,000
60	85,500	90,000	94,000	97,000
61	86,000	90,500	95,000	98,000
62	87,000	91,000	96,000	99,000
63	87,500	92,000	97,000	100,000
64	88,000	92,500	97,500	101,000
65	88,500	93,000	98,000	102,000
66	89,000	93,500	98,500	103,000

TABLE 3. — Number of possible axle-group combinations and axle-group loading limits (derived from Fig. 1 and Tables 1 and 2) for a 7-axle vehicle.

No. of axle-group combinations	Axle group		Distance (ft.)	No. of axles (<i>n</i>)	Group limit (lb.)
	First axle	Last axle			
1	1	2	18.17	2	40,000
2	1	3	22.50	3	53,000
3	1	4	45.50	4	72,500
4	1	5	49.75	5	79,000
5	1	6	65.75	6	93,500
6	1	7	81.75	7	105,500
7	2	3	4.33	2	34,000
8	2	4	27.33	3	56,000
9	2	5	31.58	4	63,500
10	2	6	47.58	5	78,000
11	2	7	63.58	6	92,500
12	3	4	23.00	2	40,000
13	3	5	27.25	3	56,000
14	3	6	43.25	4	70,500
15	3	7	59.25	5	85,000
16	4	5	4.25	2	34,000
17	4	6	20.25	3	51,000
18	4	7	36.25	4	66,000
19	5	6	16.00	2	40,000
20	5	7	32.00	3	60,000
21	6	7	16.00	2	40,000

LOG DOG

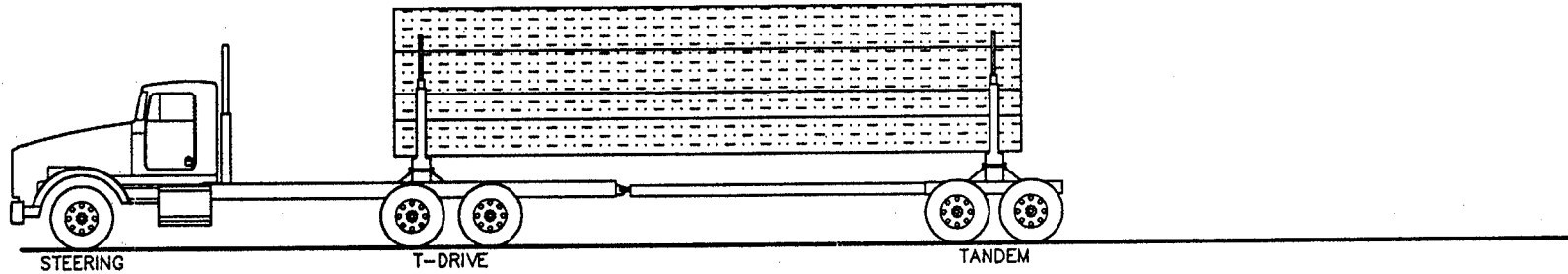


AXLE LOADINGS		POUNDS PER INCH OF TIRE WIDTH
STEERING	11,000 LBS	500
T-DRIVE	30,000 LBS	341
LOG DOG	39,500 LBS	299
TANDEM	25,000 LBS	284
GCVW		105,500 LBS
TARE		34,240 LBS
PAYLOAD		71,260 LBS

NUMBER OF TRIPS REQUIRED
TO TRANSPORT 8,900 TONS
OF PAYLOAD

250

LOG TRAILER



AXLE LOADINGS		POUNDS PER INCH OF TIRE WIDTH
STEERING	12,000 LBS	545
T-DRIVE	34,000 LBS	386
TANDEM	34,000 LBS	386
GCVW		80,000 LBS
TARE		25,200 LBS
PAYLOAD		54,800 LBS

NUMBER OF TRIPS REQUIRED
TO TRANSPORT 8,900 TONS
OF PAYLOAD

325

LOG TRUCK EFFICIENCY COMPARISONS

WESTERN TRAILERS®

208-344-2539 8700 BUSINESS WAY, BOISE, IDAHO 83705





Reduce Log Weight

- ◆ Reduce Bark
 - Mechanized delimiting
- ◆ Reduce Water
 - Girdling
 - Stockpiling

Girdling

Girdle sapwood of standing tree one to two weeks before felling and let transpiration reduce water content

Fell tree and leave top attached for several weeks

Researchable Questions

- ◆ How long does transpiration continue after full, partial girdling?
- ◆ If transpiration continues, what is the rate of water use
- ◆ Variables: species, temperature, wind

Example: mature tree during summer uses 20+ gallons (160+ lbs) per day

Benefits and Costs

Benefits

- Loading
- Hauling
- Drying

Costs

- Girdling
- Sawing productivity (?)
- Wood quality

Reduce Road User Costs

Road User Costs On Low Speed Aggregate
Surfaced Roads Are About Equal to Haul Costs

Haul Cost = $f(\text{operating cost, load, speed})$

= \$0.25-0.30/ton-mile

Maintenance Cost = \$.20-25/ton-mile

Opportunities

- ◆ Reduce tire inflation pressure
- ◆ Recycle aggregate from temporary and decommissioned roads

Lower Tire Inflation Pressure

Road Impacts

- Less rock required

- Lower road maintenance (fewer washboards and shallower ruts)

Vehicle Impacts

- Less truck maintenance (less shock)

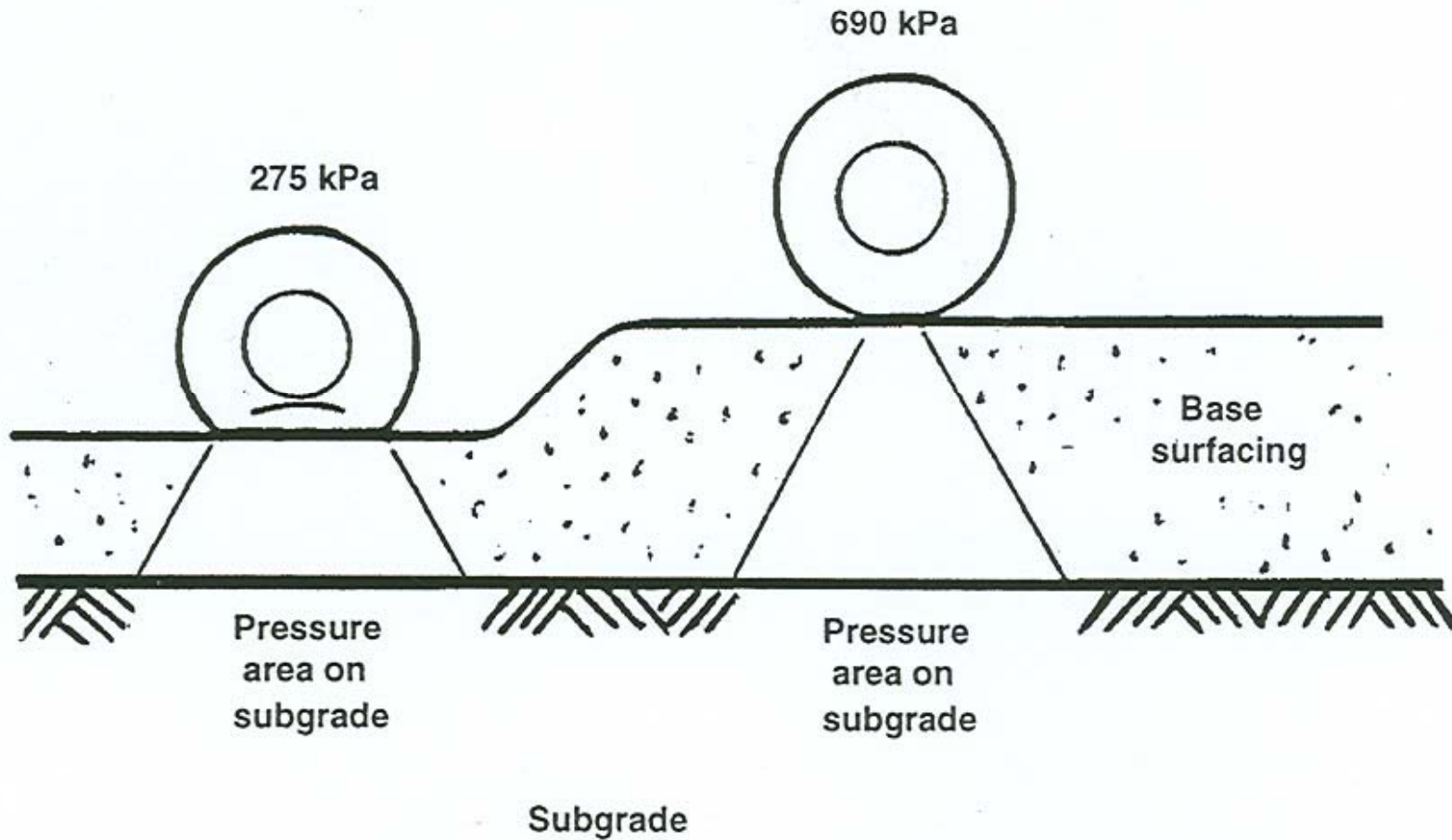
- Fewer flats (fewer punctures)

- Improved mileage (less tire slip)

Longer Hauling Season

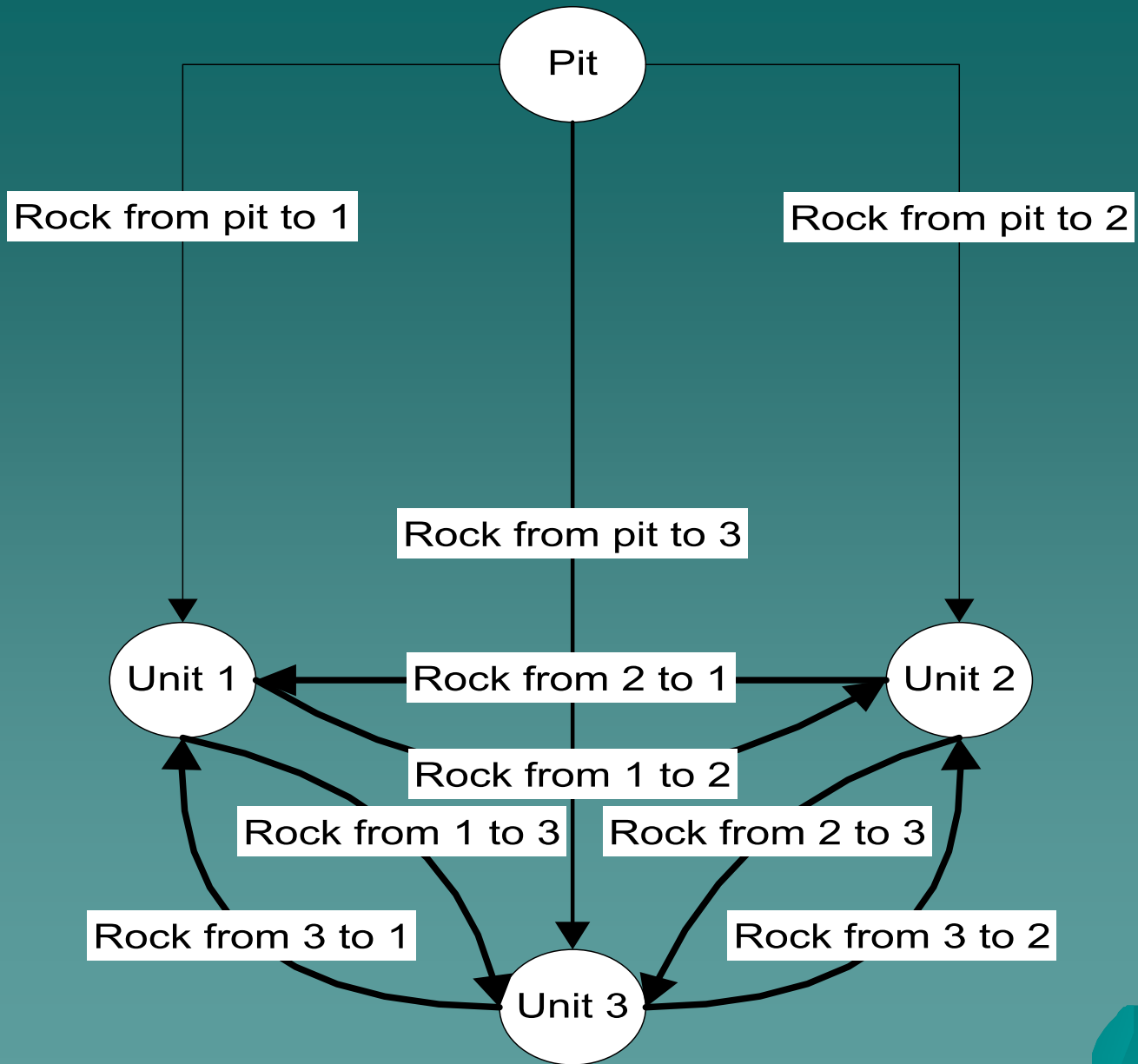


Aggregate Depth



Recycling Aggregate

- ◆ Many forest roads are used intermittently. Why let rock sit not earning interest?
- ◆ Aggregate in many locations is expensive (\$20,000-\$30,000 per mile in Coast Range).
- ◆ Harvest Scheduling and Road Operations Problem



Costs of Rock Recovery

- ◆ New Rock - \$5-20+ per ton depending on source, quality and distance
- ◆ Pickup Existing Rock - \$1-2 per ton + \$1/ton processing + \$ 0.4/ton-mile + \$0.3/ton-mile road use fee

Improve Truck Scheduling

- ◆ Reduce truck waiting times at landings and mills

30+ minute waits not uncommon

- ◆ Increase percent of loaded miles

40-45% not uncommon

Summary

Lots of opportunities for improved decision support :

- ◆ truck configurations
- ◆ load efficiency
- ◆ harvest and road operations
- ◆ truck scheduling