

A PRODUCTIVITY TIMING SYSTEM FOR TREE CLIMBING TRAINING

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Abstract. The City of Milwaukee Forestry Division manages more than 200,000 street trees and 120 mi (193 km) of landscaped boulevards. Tree pruning is a major operation that accounts for the pruning of more than 58,000 trees per year, with a majority of such work done by rope and saddle. Our program for current and newly hired employees consists of intense training during a 6-month probationary period. The cornerstone of this training program is based on building climbing proficiency and demonstrating the ability to prune a predetermined number of trees per day within certain size classes. To refine our climbing training program, we developed a unique productivity timing system utilizing a pruning study conducted by the University of Wisconsin-Stevens Point in 1992. Over 50% of our current urban forestry specialists (arborists) have been trained under this timing system. A detailed account of the evolution of our system of tree climbing training and productivity assessment will be presented and should be applicable to other urban forestry programs around the world.

Key Words. Pruning; training; climbing; urban forestry programs.

Milwaukee is the largest city in the state of Wisconsin, with a population of 638, 000 and a geographic area of approximately 100 mi² (259 km²). The City of Milwaukee Forestry Division manages more than 200,000 street trees and 120 mi (193 km) of irrigated boulevards, with a full-time staff of 190 employees supported by 70 temporary laborers hired during the growing season. The tree work is done by 114 urban forestry specialists and 22 urban forestry crew leaders. Forestry crews prune more than 50,000 trees per year using 12 aerial lift trucks and climbers. The aerial lift trucks account for fewer than 10,000 trees pruned per year, with the remaining 40,000+ trees pruned by climbers using ropes and saddles.

The Forestry Division's formal training program for new employees has been in place more than 15 years. This training program has gone through several changes during that time. The most significant change occurred in 1993, when a consultant study recommended that our arborists be used in all tree and landscape operations rather than specializing in tree maintenance. Implementing this recommenda-

tion meant cross-training our existing work force of arborists and landscape gardeners into a combined job title of urban forestry specialist. A prototype productivity timing system was used during the retraining of our then-current employees. Then, as we hired new employees, under the title of urban forestry specialist trainee, a more refined productivity timing system was put in place. The development and details of this system is discussed below.

TRAINING PROGRAM

The training crew is a mobile crew that reports directly to the field each day, which eliminates travel time to and from our district offices. This is accomplished by using mobile office trailers with individual lockers for each climber and trailers with portable toilets. These trailers are parked along the streets where the crew is pruning and are moved as often as needed to minimize the walking distance to the work area. A chipper truck and utility truck report to each crew from our district offices with chain saws and other tools each day. We staff the training crew with an urban forestry supervisor (management position) and an urban forestry crew leader (union foreman position), who are responsible for managing the day-to-day training and operations of the crew. They are supported by one urban forestry specialist trainer for every 5 trainees. As trainees leave the program, the number of trainers is reduced proportionally.

A person enters our program as an urban forestry specialist trainee by applying for the position when it is advertised by the City of Milwaukee. Typically, more than 600 people apply for the position of urban forestry specialist trainee. The application process has a written exam and field performance exam. The written civil service exam is a general aptitude test and does not show preference for people with previous arboricultural experience. Persons with the top 75 written exam scores are invited to the field performance exam given at a park. The performance exam includes stations with belayed rope climbing, belayed free climbing, sandbag loading, and moving a balled-and-burlapped tree on a ball cart through a

measured course. These field tests screen applicants for strength and fear of heights, prior to a position being offered. The combined scores from the written and field exams rank all eligible candidates on a list that is used for several years of hiring before a new list is developed following the same process. The top candidates from the list are invited to interview, with employment offers made to the best candidates.

Each trainee entering the training program is issued an urban forestry specialist training manual. This manual, developed through a state urban forestry grant, contains the primary training information for the entire training program. The content includes everything from physical conditioning to climbing and rigging to tree biology. During the training program, each topic is first introduced in the classroom, then is followed by field demonstrations and finally performed (with coaching) by each trainee. Our basic training philosophy is "tell me, show me, let me," which we practice throughout the formal training period for new employees.

The urban forestry specialist training program requires eighteen months to complete. The first six months of employment are spent under probation as an urban forestry specialist trainee, followed by promotion through exam to the urban forestry specialist position. We focus on tree climbing training during the probationary period. Each employee must meet the rope and saddle climbing performance requirements necessary to become part of our work force. Persons not meeting the performance requirements during the probationary period either have their probation extended or are terminated from the training program. Training in all other aspects of tree and landscape maintenance is carried out during the 12 months immediately following the 6-month probationary period.

The training crew begins with classroom instruction in climbing, pruning, and safety, prior to climbing trees in a park. Trainees start out by removing deadwood in small to medium-sized trees (8 to 16 in. [20 to 40 cm] dbh) before moving on to climbing and deadwooding large trees, graduating eventually to street tree structural pruning.

TIMING SYSTEM

Over the years, the division has tried to objectively evaluate the climbing speed and pruning quality of trainees. Several methods were developed to deter-

mine minimum tree climbing competence. The first involved specifying a minimum number of trees within certain size classes that should be climbed and pruned each day. A second system used experienced trainers to estimate the time required to prune each tree. The third and current system is based on a research project that analyzed the time required to prune trees within Milwaukee's urban forest (Churack et al. 1994). The study focused on green ash (*Fraxinus pennsylvanica*), littleleaf linden (*Tilia cordata*), honeylocust (*Gleditsia triacanthos*), and Norway maple (*Acer platanoides*), the 4 species that make up the majority of Milwaukee's street tree population. The study looked at average pruning times for size classes (from 4 to 16 in. [10 to 40 cm] dbh, increasing at 2-in. [5-cm] increments) for each species. This information was used to develop an average pruning time for all tree species within those size classes. Using this data, average pruning times were estimated for trees over 16 in. dbh (to a maximum allowed time of 3 hours for trees 26 in. [66 cm] dbh and larger). These average expected pruning times for various size trees provide the minimum baseline for acceptable productivity.

The actual timed performance of each trainee is compared to the expected performance. The 2-sided Daily Productivity Report form has been developed to record trainee climbing and pruning performance (Figures 1 and 2*). An urban forestry specialist trainer monitors the performance of 5 trainees each day. The trainer uses a separate Daily Productivity Report form for each trainee, recording the address and diameter of each tree completed that day (Figure 1). Figure 2 shows the calculation side of the form. In the daily climbing time section (Figure 2, lower left-hand corner), the trainer subtracts any time the trainee was not climbing and pruning during the 8-hour work day (e.g., chipping, raking, cleaning up). At the end of the work day, the information recorded for tree sizes completed (Figure 1) is transferred to the calculation chart on the opposite side of the form (Figure 2). The allowed standard pruning time for each 2-in. [5-cm] size class tree is then calculated. This total allowed pruning time is then entered as total tree pruning time (lower right-hand corner of side two) The climber is allowed one-tenth of an hour (6 minutes) between trees. Time allowed between trees is added to the total standard pruning

*Figures for this article begin on page 101.

time, yielding the expected total calculated climbing time. The total calculated climbing time is divided by the actual daily climbing time performance of the trainee. When multiplied by 100, this ratio gives us the climber's daily percentage productivity rating. A trainee working slower than the expected time receives a productivity percentage rating less than 100%. Conversely, a trainee working faster than the expected minimum performance receives a productivity percentage rate greater than 100%. It is important to remember that a 100% performance rating just meets the minimum acceptable level of productivity.

Figures 3 and 4 are examples of a completed daily productivity report. The information recorded in Figure 3 has been transferred to the calculation chart (Figure 4). The allowed standard pruning time for the 4 trees completed that day has been calculated and the daily climbing time has been figured. This information has been used to calculate the daily percentage productivity rating. This example shows a trainee who worked below the minimum productivity standard. Figure 5 reflects the productivity calculation of a trainee who has exceeded the minimum productivity standard. The 42% increase in productivity from Figure 4 to Figure 5 is the result of the trainee having pruned 1 additional tree of a relatively large diameter.

Figure 4 represents a typical climbing day for a trainee 2 to 3 months into the program. Figure 5 exemplifies the same climber 2 to 3 months later. The productivity increase reflects improved skills in both climbing and pruning. To successfully complete the probationary period of training (by the end of 6 months), a new employee must be able to average 100%, or better, for a minimum of 15 consecutive climbing days.

It should also be noted that quality, in addition to quantity, is required. Trainees must thoroughly prune each tree, removing all deadwood 0.5 in. (1.3 cm) in diameter and larger. Whenever possible they must also perform structural pruning toward development of a single central leader in each tree. Proper pruning decisions and cuts are both taught and expected.

The comment section of the form (Figure 1) allows the trainer to record information relevant to productivity performance. This may include unusual conditions of particular trees, unusual or suspect employee behavior, equipment problems (e.g., chain saw that won't run properly), and exhibition of em-

ployee skills (or lack thereof) that should have been learned by that point in the training process. This information supplements, and at times explains, the measured performance statistics of each trainee on any particular day. Each trainer is asked to note positive and negative comments on these forms to acknowledge good performance as well as deficiencies.

The comments and daily percent productivity are used to identify patterns of a trainee's overall development. This information is used to address weaknesses in the performance of each trainee, so that corrective measures can be taken. It is also used to reinforce good performance based on the productivity percentages and comments. Formal evaluations are given each month, with written goals for the following evaluation cycle during the program.

This timing system is not perfect, but it has served our needs very well during the past 4 years. Problems can arise if pruning expectations are not consistent from trainer to trainer and when certain tree species that are particularly easy or difficult to prune dominate an area leading to very high or low daily percent productivity averages. Another problem is trying to use this system over a short time period. Our trainees are timed for a minimum of 5 months, allowing their average daily percent productivity to truly reveal itself. Typically 35% to 45% of the people entering this training program successfully complete the 6-month probationary period and take the promotional exam to become urban forestry specialists. Most of the people who leave our program during the first 6 months do so by voluntary resignation (usually within the first month of employment). Lack of desire to climb trees on a daily basis and physical capabilities are often contributing factors. Therefore, to meet our staffing needs we frequently hire additional people from the ranked eligibility list to fill the vacancies created by trainees leaving our program during the first month of training.

CONCLUSION

The City of Milwaukee invests in the long-term care and safety of its urban forest with each training crew we hire. One goal of our entry-level urban forestry specialist training program is to develop employees with solid, fundamental arboricultural skills. Through classroom instruction, demonstration, and supervised field training, the foundation is set. The timing system is a successful training tool that allows

objective evaluation of each trainee's productivity in a consistent and fair manner. Our training system also provides for subjective evaluation of individual strengths and weaknesses, complementing the timing data we collect. This information is used to give trainees the performance feedback they need to work toward successful completion of the training program and promotion to urban forestry specialist.

LITERATURE CITED

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Résumé. La division Foresterie de la ville de Milwaukee gère plus de 200000 arbres de rues et plus de 192 km de boulevard aménagés. L'élagage des arbres est une opération majeure qui s'effectue sur plus de 58000 arbres par an, principalement par la technique de montée au câble. Notre programme de formation pour le personnel courant et les nouveaux employés se compose d'une période probatoire de formation intensive de six mois. La formation inclut des cours théoriques en classe, des démonstrations sur le terrain et de la pratique répétitive sur tous les aspects de la plantation, de l'élagage et de l'abattage. La pierre angulaire de ce programme de formation est basée sur l'acquisition d'une compétence en techniques de montée et sur la démonstration d'habilités pour élaguer un nombre prédéterminé d'arbres par jour selon certaines classes de diamètres. Pour raffiner notre programme de techniques de montée, nous avons développé un système unique de mesurage des temps productifs en utilisant une étude sur l'élagage menée par l'Université du Wisconsin à Stevens Point en 1992. Plus de 50% de notre personnel spécialiste (arboriculteurs) régulier ont été entraînés à ce système de productivité. Un exposé détaillé de l'évolution de notre système de techniques de montée et de l'évaluation de la productivité sera présenté et devrait s'avérer applicable à d'autres programmes de foresterie urbaine ailleurs dans le monde.

Zusammenfassung. Die Forstabteilung der Stadt Milwaukee bewirtschaftet über 200.000 Strassenbäume und 120 Meilen von angelegten Boulevards. Der Baumschnitt ist eine Hauptaufgabe und bedeutet, daß über 58.000 Bäume pro Jahr gepflegt werden müssen, die Mehrheit davon mit Seil und Klettergurt. Unser Trainingsprogramm für kürzlich neu eingestellte Mitarbeiter besteht aus einem intensiven Trainingsprogramm über eine sechsmonatige Probezeit. Die Ausbildung umfasst Instruktionen im Klassenraum, Felddemonstrationen und wiederholte Übungen in allen Aspekten der Baum -pflanzung, -pflege und -fällung. Der Eckstein dieses Programms basiert darauf, eine Professionalität im Klettern aufzubauen und zu demonstrieren, daß eine bestimmte Anzahl an Bäumen innerhalb einer Größenklasse pro Tag zu pflegen sind. Um unser Klettertrainingsprogramm zu verfeinern, haben wir ein einzigartiges System zur Produktivitätsmessung entwickelt, die auf einer Pflegeschnittstudie beruht, die von der Universität von Wisconsin - Stevens Point 1992 geleitet wurde. Über 50 % der gegenwärtigen Arboristen (Baumpfleger) wurden mit diesem System ausgebildet. Hier wird eine detaillierte Information über den Wert des Klettertrainings und der Produktivitätsprüfung dargestellt, welche auch für andere Forsteinrichtungen in aller Welt angewendet werden könnte.

Resumen. La División Forestal de la Ciudad de Milwaukee maneja cerca de 200,000 árboles urbanos y 120 millas de bouleverares paisajísticos. La poda de árboles es la principal operación que contabiliza arriba de 58,000 árboles por año con una mayoría hecha con cuerda y silla de trepa. Nuestro programa de entrenamiento para empleados nominales y recientemente contratados consiste de un intenso programa de entrenamiento en los árboles durante un periodo de prueba de 6 meses. El entrenamiento incluye instrucción en el salón, demostraciones de campo y experiencia repetitiva en todos los aspectos de plantación de árboles, poda y remoción. La piedra angular de este programa de entrenamiento está basada en la estructuración de un entrenamiento en trepa y la demostración de la habilidad para podar un número determinado de árboles por día dentro de cierta clase de tamaño. Para refinar nuestro programa de entrenamiento en trepa desarrollamos un sistema de productividad único, utilizando un estudio conducido por la Universidad de Wisconsin-Stevens Point en 1992. Arriba del 50% de nuestros actuales especialistas forestales urbanos (arboristas) han sido entrenados bajo este sistema. Se presentará una contabilidad detallada de la evolución de nuestro sistema de entrenamiento y la evaluación de la productividad, lo cual debe ser aplicable a otros programas forestales urbanos alrededor del mundo.

DAILY PRODUCTIVITY REPORT

NAME: _____ DATE: _____

	ADDRESS	TREE DBH (inches)
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		
17.		
18.		
19.		
20.		
21.		
22.		
23.		

COMMENTS: _____

Figure 1. Front of the two-sided Daily Productivity Report form on which the address and diameter of each tree is recorded along with positive and negative comments.

DAILY PRODUCTIVITY REPORT

NAME: _____

DATE: _____

TREE SIZE CLASS (DBH IN INCHES)	STANDARD PRUNING TIME PER TREE (HRS)	x	NUMBER OF TREES PRUNED	=	TREE PRUNING TIME (HRS)
2.0 - 3.9	0.2	x		=	
4.0 - 5.9	0.3	x		=	
6.0 - 7.9	0.5	x		=	
8.0 - 9.9	0.7	x		=	
10.0 - 11.9	1.0	x		=	
12.0 - 13.9	1.2	x		=	
14.0 - 15.9	1.5	x		=	
16.0 - 17.9	1.7	x		=	
18.0 - 19.9	2.0	x		=	
20.0 - 21.9	2.2	x		=	
22.0 - 23.9	2.5	x		=	
24.0 - 25.9	2.7	x		=	
26 +	3.0	x		=	
TOTALS					

<u>DAILY CLIMBING TIME</u>	<u>DAILY % PRODUCTIVITY</u>
8 HOURS	
- _____ BREAK (HRS)	+ _____ TOTAL TREE PRUNING TIME
- _____ CLEANUP (HRS)	+ _____ TIME BETWEEN TREES
- _____ OTHER (HRS)	= _____ TOTAL CALCULATED CLIMBING TIME
= _____ TOTAL HOURS	÷ _____ DAILY CLIMBING TIME
	x _____ 100
	= _____ DAILY % PRODUCTIVITY

DEFINITIONS

- Daily Climbing Time = 8 hour day minus rest break, cleanup, and other non-climbing time.
- Total Pruning Time = standard pruning time x trees pruned per size class.
- Time Between Trees = number of trees pruned x 0.1 hour.
- Total Calculated Climbing Time = total tree pruning time + time between trees.
- Daily % Productivity = total calculated climbing time ÷ daily climbing time x 100.

Figure 2. Back side of the two-sided Daily Productivity Report form on which the calculations are performed to determine the daily percentage productivity rating at the end of each climbing day.

DAILY PRODUCTIVITY REPORT

NAME: _____

DATE: _____

ADDRESS	TREE DBH (inches)
1. 5062 N. Sherman Blvd.	7.0
2. 4423 W. Fairmount Ave.	10.5
3. 4433 W. Fairmount Ave.	11.5
4. 4440 W. Stark Ave.	19.0
5.	
6.	
7.	
8.	
9.	
10.	
11.	
12.	
13.	
14.	
15.	
16.	
17.	
18.	
19.	
20.	
21.	
22.	
23.	

COMMENTS: _____

Employee had trouble reaching the dead tips on the large trees.

Figure 3. Example showing a daily productivity report form for a climber pruning 4 trees, with comments regarding the trainee's performance.

DAILY PRODUCTIVITY REPORT

NAME: _____

DATE: _____

TREE SIZE CLASS (DBH IN INCHES)	STANDARD PRUNING TIME PER TREE (HRS)	x	NUMBER OF TREES PRUNED	=	TREE PRUNING TIME (HRS)
2.0 - 3.9	0.2	x		=	
4.0 - 5.9	0.3	x		=	
6.0 - 7.9	0.5	x	1	=	0.5
8.0 - 9.9	0.7	x		=	
10.0 - 11.9	1.0	x	2	=	2.0
12.0 - 13.9	1.2	x		=	
14.0 - 15.9	1.5	x		=	
16.0 - 17.9	1.7	x		=	
18.0 - 19.9	2.0	x	1	=	2.0
20.0 - 21.9	2.2	x		=	
22.0 - 23.9	2.5	x		=	
24.0 - 25.9	2.7	x		=	
26 +	3.0	x		=	
TOTALS			4		4.5 hrs.

<u>DAILY CLIMBING TIME</u>	<u>DAILY % PRODUCTIVITY</u>
8 HOURS	<u>4.5</u> TOTAL TREE PRUNING TIME
- <u>0.3</u> BREAK (HRS)	+ <u>0.4</u> TIME BETWEEN TREES
- <u>1.0</u> CLEANUP (HRS)	= <u>4.9</u> TOTAL CALCULATED CLIMBING TIME
- <u>0.5</u> OTHER (HRS)	+ <u>6.2</u> DAILY CLIMBING TIME
= 6.2 TOTAL HOURS	x <u>100</u>
	= 79.0 DAILY % PRODUCTIVITY

DEFINITIONS

- Daily Climbing Time = 8 hour day minus rest break, cleanup, and other non-climbing time.
- Total Pruning Time = standard pruning time x trees pruned per size class.
- Time Between Trees = number of trees pruned x 0.1 hour.
- Total Calculated Climbing Time = total tree pruning time + time between trees.
- Daily % Productivity = total calculated climbing time ÷ daily climbing time x 100.

Figure 4. Calculations for the climber shown in Figure 3. Note that the climber had difficulty reaching the dead tips, which resulted in a daily productivity rating of 79%.

DAILY PRODUCTIVITY REPORT

NAME: _____

DATE: _____

TREE SIZE CLASS (DBH IN INCHES)	STANDARD PRUNING TIME PER TREE (HRS)	x	NUMBER OF TREES PRUNED	=	TREE PRUNING TIME (HRS)
2.0 - 3.9	0.2	x		=	
4.0 - 5.9	0.3	x		=	
6.0 - 7.9	0.5	x	1	=	0.5
8.0 - 9.9	0.7	x		=	
10.0 - 11.9	1.0	x	2	=	2.0
12.0 - 13.9	1.2	x		=	
14.0 - 15.9	1.5	x		=	
16.0 - 17.9	1.7	x		=	
18.0 - 19.9	2.0	x	1	=	2.0
20.0 - 21.9	2.2	x		=	
22.0 - 23.9	2.5	x	1	=	2.5
24.0 - 25.9	2.7	x		=	
26 +	3.0	x		=	
TOTALS			5		7.0 hrs.

<u>DAILY CLIMBING TIME</u>	<u>DAILY % PRODUCTIVITY</u>
8 HOURS	<u>7.0</u> TOTAL TREE PRUNING TIME
- <u>0.3</u> BREAK (HRS)	+ <u>0.5</u> TIME BETWEEN TREES
- <u>1.0</u> CLEANUP (HRS)	= <u>7.5</u> TOTAL CALCULATED CLIMBING TIME
- <u>0.5</u> OTHER (HRS)	÷ <u>6.2</u> DAILY CLIMBING TIME
= 6.2 TOTAL HOURS	x <u>100</u>
	= 121.0 DAILY % PRODUCTIVITY

DEFINITIONS

- Daily Climbing Time = 8 hour day minus rest break, cleanup, and other non-climbing time.
- Total Pruning Time = standard pruning time x trees pruned per size class.
- Time Between Trees = number of trees pruned x 0.1 hour.
- Total Calculated Climbing Time = total tree pruning time + time between trees.
- Daily % Productivity = total calculated climbing time ÷ daily climbing time x 100.

Figure 5. Calculations for the same climber as in Figures 3 and 4, with 1 additional tree added in the 22- to 23.9-in. [55.9 to 60.7cm] dbh class. This increased the productivity rating from 79% to 121%.