P&IM

PRODUCTION AND INVENTORY MANAGEMENT JOURNAL

PUBLISHER
APICS The Association for Operations Management

2010

Logistics of the American Circus: The Golden Age

Vincent A. Mabert *(Corresponding author)*
Kelley School of Business, Indiana University (Emeritus), Bloomington, IN, 47405, mabert@indiana.edu

Michael J. Showalter
College of Business, Florida State University (Emeritus), Tallahassee, FL, 32306, mshowalter@cob.fsu.edu

ABSTRACT

Competitive pressures today require enterprises to continually improve performance for various business activities, such as customer service or waste reduction. One area currently receiving significant attention is the logistics function within organizations. In the last decade, numerous authors have proposed many modern logistics management principles and practices that focus on dimensions such as lean, fast, flexible, and so on. Many of these approaches are not new, but rather have been used and refined by business organizations in earlier times. In this paper, we describe many logistics methods employed by the major circuses more than a century ago. While the technology and terminology of that time were different, similarities with current management thought and practice are evident. Hopefully, by reviewing these logistics activities from a century ago, new ideas about logistics for tomorrow can be formulated.

Keywords: logistics, transportation, stowage, circus operations

INTRODUCTION

Let us turn back the clock to another era! It is early Friday morning, August 9, 1895, in Connersville, Indiana, and the "Barnum & Bailey Greatest Show on Earth" circus train has arrived in town for a one-day stand. The circus's scheduled street parade is set for 11:00 a.m., with performances to follow at 2:00 p.m. and 8:00 p.m. With the circus in town, the community has declared a "holiday," and most local businesses and government offices are closed. Paying only 50 cents per ticket (25 cents for children), nearly everyone in the community of more than 7,000 souls, as well as those living in the surrounding countryside, will be at the circus. If the evening performance sells out, there will be 9,000 people watching the show.

The public will absorb the unique sights, sounds, smells, pageantry, and excitement generated by the circus parade and shows. They will marvel at the exotic animals, sideshow oddities, death-defying acts, and aerial artistry of the performances. Magnificent clowns will provide smiles and laughter. This circus experience is something that stays in the memory of the audience, both parents and children.

Given that over 50 percent of the country's population in 1895 is rural and relatively isolated, it is easy to understand why the traveling circus is the No. 1 form of entertainment in America. Although Barnum & Bailey is one of the largest circuses, dozens of smaller ones crisscross America, making similar one-day stops in other towns.

Now let's peek behind the curtain of the Barnum & Bailey circus. For the parade and performances to go on today as scheduled, a large contingent of circus employees is needed—700 people (400 workers and 300 performers). In addition, a large number and variety of animals is needed—300 horses (200 baggage and 100 ring), plus numerous exotic animals such as lions, tigers, elephants, camels, zebras, rhinoceroses, hippopotami, monkeys, llamas, and more. (Moffett 1895). Also, tons of supporting resources (equipment and materials) are available to assist the employees and animals.

Circus management must acquire, allocate, and coordinate all these employees, animals, and resources so that today's parade and performances adhere to a tightly developed schedule. Oh, and by the way, after the last performance ends at 10:30 p.m., management is responsible for moving (sometimes 100-plus miles) the entire circus—people, animals, and equipment/materials—by rail from this town to arrive at the next *before sunrise*. This daily ritual of arrive, unload, deploy, perform, pack, load, and move on will typically occur 150 times during a seven-month season.

As one might imagine, supporting the daily

activities and movement of the circus employees, animals, and equipment/materials more than a century ago was a massive logistics challenge. Although circus management did not label this task as "logistics management," they did, in fact, develop specialized logistics practices to achieve their seemingly impossible operational goals.

In this article, we intend to examine many features of the American circus that traveled by railroad during its Golden Age[1] and to highlight many of its specialized logistics practices we now consider to be common principles underlying modern logistics management. To set things into perspective, the next section provides a historical review of the circus, which is followed by a detailed description of typical operational activities for a circus show day. We next highlight the many logistics uncertainties faced by the circus, and then discuss the practices and principles they employed to be commercially successful enterprises.

CIRCUS BACKGROUND

While this short historical sketch cannot do justice to the rich and colorful heritage of the circus, it is meant to provide the reader a background for the different approaches and processes employed in managing a circus. The interested reader can consult many of the references cited at the article's end for further background information. Hoh and Rough (1990) provide a nice overall coverage.

The modern concept of a circus presented in a circular arena dates to the early 18th century. It has roots in the exhibition of equestrian skills, which was popular in England at the time. Over the years, other acts such as clowns and jugglers were added to the performance. Originally, these circuses performed in theaters or permanent arenas in large cities that could accommodate the events. But in 1825, Joshua Purdy Brown was the first circus in America to use a large canvas tent. The use of a tent enabled circuses the opportunity to travel by horse-drawn wagon to more remote, rural locations (Hoh and Rough 1990).

At the same time, the public was interested in seeing exotic animals that were often written about but not readily accessible, since zoos were uncommon in America during this time. This gave rise to the traveling menagerie, where elephants, lions, monkeys, and other animals could be seen by the local population. The addition of the menagerie became the final major structural element defining the American circus.

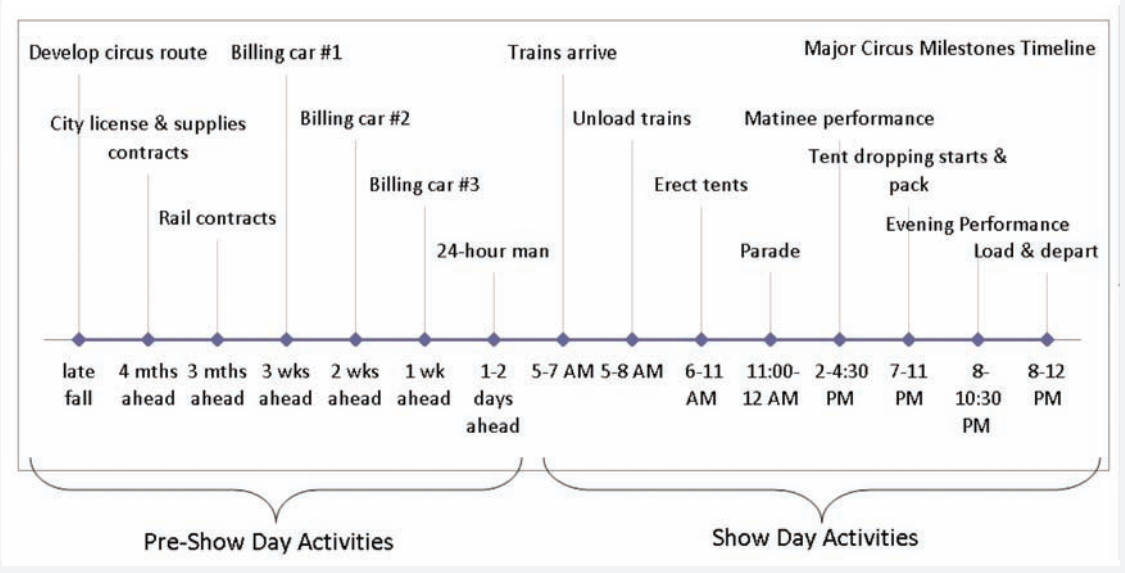
The early circuses of the 1800s traveled America using horse-drawn wagons. Some larger shows required 300 to 400 draft stock horses (primarily Percherons) to transport the dozens of wagons necessary to move the circus from one town to another. The typical distance a circus could travel by (dirt) road per night was 10-15 miles, with good weather conditions. Thus, the choice of town to perform in next was limited to those towns within 10-15 miles of the current location.

The first pioneer in transporting a circus by rail was Dr. Gilbert A. Spaulding, an Indiana druggist and part owner of a small circus. In 1856, his circus traveled on nine railroad cars custom-built by James Goold & Sons of Albany, NY. In 1871, William Coup, with support from P.T. Barnum, put together a show that traveled by rail. Rail travel enabled the circus to move 50-200 miles per night, depending on weather and track conditions. Moving by rail added flexibility in the choice of which town to visit next. Rather than play the next "small" town, the circus could choose to jump (100-plus miles) to larger cities. Coup reasoned that with receipts of $5,000-$7,000 in larger cities versus $2,000 in smaller ones, the added cost of rail travel would be offset by the higher revenues in larger cities, resulting in greater profitability. (Hubbard 1923, p. 56)

During the late 1800s and early 1900s, more circuses employed railroads to move from one town to another. The high point in railroad circus travel was 1911, when more than 30 circuses moved by rail. These circuses varied in size, requiring a different number of rail cars. For example, the Al G. Barnes, Sells Floto, and Hagenbeck-Wallace circuses used between 17 and 48 rail cars. The Ringling Bros. and Barnum & Bailey big circus shows each required 84 cars (divided into sections of about 20) to move all the workers, performers, animals, and equipment (Parkinson and Fox 1978, p. 26).

[1] *It is difficult to provide a precise time interval, but the Golden Age is generally agreed to span the period 1890 through 1930, when the circus was the No. 1 form of entertainment in America.*

FIGURE 1: Typical Circus Time Line



The figure illustrates the major early tasks to be completed prior to the actual show date for the circus, plus the critical within-day activities.

HOW THE CIRCUS "CAME TO TOWN"[2]

Planning and preparation were important tasks for the circus to arrive and depart smoothly at each town. As Figure 1 illustrates, the planning process began months in advance of the actual show date, with early visitations to the town by contracting agents and promotional billing staff. Then one or possibly two days prior to the arrival of the circus train, the "advance man," also referred to as the "24-hour man," arrived to ensure that everything was in order. He first checked the show lot site to determine whether any changes such as grading, moving obstacles, cutting down trees, and so on were needed. Based on the lot site characteristics, he prepared a proposed schematic of where the tents would be located on the lot. Next, he visited the train station and determined where the circus trains would unload at the rail yard. He arranged for any planking and grading to ensure the smooth transition of circus wagons and equipment from the rail cars to the ground. Next, he telegraphed instructions to the circus train master to load the circus wagons "poles to engine," or "poles to caboose" so the wagons faced toward the front or back of the train, respectively. These instructions significantly affected the ease with which the circus train could be unloaded at the next town. He also selected and marked the street route the circus wagons and equipment would travel between the rail yard and the show lot.

In addition, the advance man contacted local suppliers that had contracts to provide the circus with food, feed, and other supplies to remind them of their commitments and to inform them of the time and location(s) to deliver their supplies. These supply contracts were established by a contract agent who may have visited the town previously (as much as three months earlier) if the town had not played host to the circus before. But if the circus was familiar with the town's suppliers due to prior visits, the supply contracts may have been established via written communications.

[2] *The information included in this section focuses upon the daily tasks and activities of the two largest rail road circuses of the 1890s and early 1900s. They were the "Ringling Bros. World's Greatest Shows Circus" and "Barnum & Bailey Greatest Show on Earth Circus." Other circuses from Forepaugh-Sells Bros. and Hagenbeck-Wallace followed similar procedures, but were half the size. The following data sources were used for this description: Jerry Apps, 2005,* Ringlingville *USA, Madison, WI: Wisconsin Historical Society, pp. xviii-xxii; Cleveland Moffett, 1895, "How the Circus is Put Up and Taken Down",* McClure's Magazine*, Vol. 5, No. 1 (June), pp. 49–61; William C. Thompson, 1905,* On the Road with a Circus*, New York: New Amsterdam Book Co., New York, pp. 29-57; Dixie Willson, 1932,* Where the World Folds up at Night*, New York: D. Appleton & Company, pp. 63–70.*

FIGURE 2: Barnum & Bailey Circus – 1908 Train Loading Information

	Train Section #1	Train Section #2	Train Section #3	Train Section #4
Cars	16 flat (6 @ 50 ft. & 10 @ 60 ft.) 3 baggage stock 2 sleeper	9 flat (5 @ 50 ft. & 4 @ 60 ft.) 6 baggage stock 5 sleeper 1 dining	14 flat (14 @ 60 ft.) 5 baggage stock	1 trunk 6 animal stock 5 ring stock 5 sleeper 1 private
Cargo – equipment wagons	Cook house wagons (4) Stake driver Buggy Water wagons (3) Stable Big Band Calliope Stable wagon (2) Stable poles Stable tools Menagerie stakes Menagerie poles Menagerie canvas Commissary Blacksmith Europe Asia Animal gear Animal wagons (30)	Side show (2) Business Buggy Property pole Ambulance Dress R. canvas Dress R. stakes Big Top stakes (2) Big Top canvas (2) Big Top poles Quarter poles (2) Chandelier (3) Trappings Rope Props Wardrobe	Africa Queen America Props Chariots (4) Buggy Egypt Chairs (3) Tkt. Wagons (2) Seat Planks (8) Stringers (4) Jacks (2) Props (7) Wardrobe Ring curb Tableau	
Total No. Wagon	53	23	45	
Wagon Linear Footage	894	469	824	
Cargo - stock	Baggage stock – 66 horses Caged animals	Baggage stock – 126 horses	Baggage stock – 110 horses	elephant (20) camel (10) pony (14) ring stock – 128 horses

A total of 79 rail cars comprised the 1908 Barnum & Bailey performing circus. Three additional rail coach cars traveled in advance of the show for promotional billing.

Source: Barnum & Bailey Circus, 1908 Train Loading Memorandum, Special Circus Collection, Milner Library, Illinois State University, Normal, IL.

On the day of the circus, sometime before 5:00 a.m. (noted in Figure 1), the first of four train sections arrives at the local train station.[3] Each section contains a vast array of equipment, wagons, animals and personnel, as shown in Figure 2 for the 1908 Barnum & Bailey circus.

The first section is met by the advance agent who takes the boss canvas man and his layout crew to the show lot site. Once at the lot, the layout crew begins the process of staking out the locations for the 18 or more tents. If the circus had visited the town/site lot before, the tent lay-out will likely utilize the previous layout scheme. The crew chief instructs the layout crew to set the hundreds of small, two-to-three-foot-long

3 The Ringling Bros. and Barnum & Bailey circus referred to the first train section as the "Flying Squadron." Its task was to rapidly organize the show lot and support the remaining circus elements.

iron pins that will define where each tent and its poles will be placed. Locating the "Big Top" tent on the show lot is critical, because all other tents are positioned relative to it. At its largest, the Big Top, where the major performances are held, is 440 feet long and about 190 feet wide and seats more than 10,000 people, with ample room for three rings and hippodrome race track.

At the train rail yard, workers begin unloading the (fully harnessed) baggage horses, which are used to move the circus wagons to the show lot. Other workers immediately begin unloading circus wagons by first setting up a run (ramp) at the end of the first flat car. The run consists of a pair of long gang planks made of wood and iron with one end attached to the flat car and the other end fastened to the ground, as shown in Figure 3. A team of horses on a long rope attached to the first wagon slowly pull it forward down the run. When the wagon clears the run, the horse team is unhitched, moved, and repositioned for hitching to the next wagon. Each circus wagon is removed from the flat car in the same manner. As one flat car is unloaded, "crossover plates" were positioned over the gaps between the flat cars, and all circus wagons were eventually unloaded via the run.

Depending on the size and weight of the circus wagon unloaded, Percheron horse teams of varying sizes (two, four, six, etc.) were hitched to the wagons and begin pulling them to the show lot. The show lot may be only a few blocks, or a few miles, from the rail yard. Because the first wagons routinely moved to the show lot in the dark, the route was typically marked with flares. For the daylight trips, however, the advance man would have marked the route with arrows at the intersec-

FIGURE 3: Flat Car Unloading

Pictured: Two Percheon horses pull a wagon that is guided by a poler worker to "run" (steel planks on jacks) at the end of a flat car.

Source: Collection of the John and Mable Ringling Museum of Art Tibbals Digital Collection, Sarasota, FL.

tions.

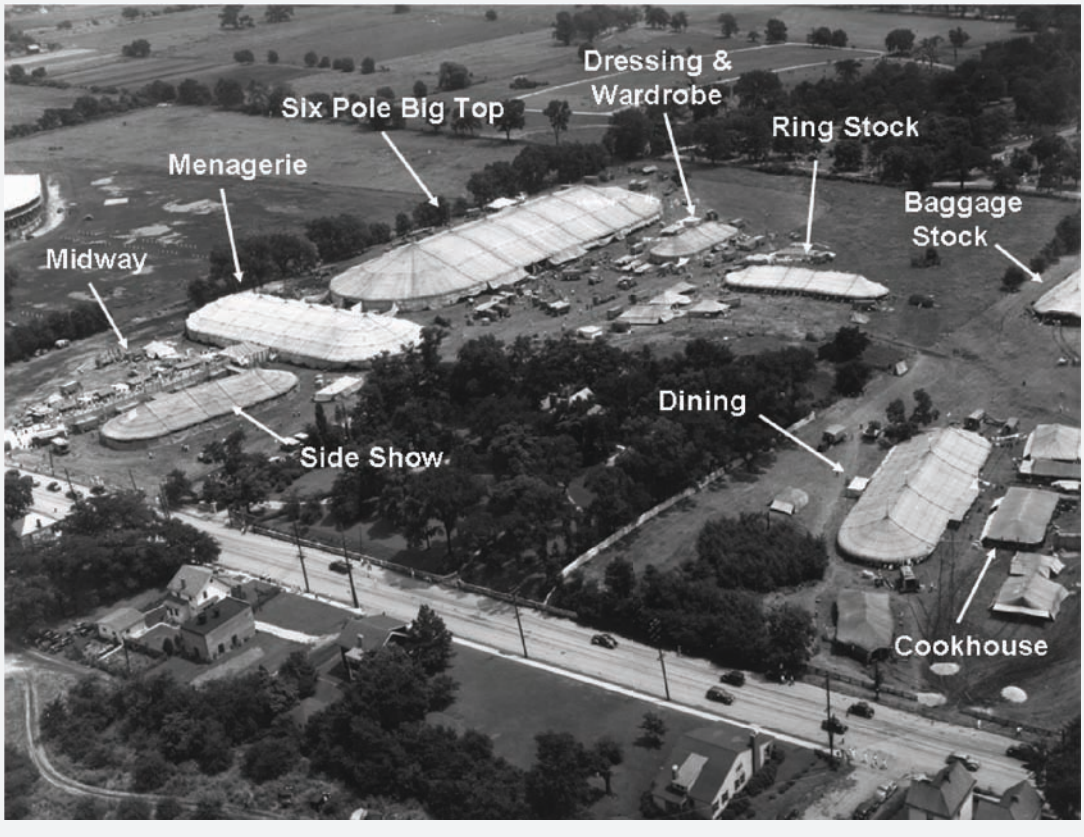
By the time the first train section is unloaded, the second train arrives. It is spotted in the rail yard, and the unloading process described above is repeated. This continues until all four train sections are unloaded and all the performers, workers, animals, supplies, and equipment are moving toward the show lot.

In the dim morning light, as the layout crew begins laying out the show lot, the cook staff quickly erects the cooking and dining tents under which "fired up" stoves, kitchen equipment, a refrigerator, dishes, tableware, and water wagons are positioned. The cook staff prepares the breakfast while the wait staff sets up the dining tent for breakfast service. By 6:00 a.m., waiters dressed in white will be ready to serve breakfast to the crew. A flag labeled "HOTEL" is run up the center pole of the dining tent, indicating to all circus employees that breakfast service has begun.

The Big Top's pole, stake, and canvas wagons arrive on the second train section When these wagons are unloaded and arrive at the show lot (as described above) the task of raising the Big Top begins. Raising the Big Top is a complex process involving the coordinated efforts of dozens of workers, horses, and elephants. When the Big Top is in position, workers move in, setting up the interior by positioning the three show rings, seating, rigging, and hundreds of other details. To expedite operations, bleacher sections are color coded to facilitate assembly.

Besides the Big Top, other tents including the baggage horse, menagerie, dressing room, sideshow, wardrobe, harness repair, blacksmith, and barber are raised in place. (See Figure 4 for Ringling Bros. circus city layout with major tents labeled.) Throughout the morning, local mer-

FIGURE 4: Show Lot Layout with Labeled Tents (labels added by authors)



Source: Collection of the John and Mable Ringling Museum of Art Tibbals Digital Collection, Sarasota, FL.

chant dray wagons of various sizes and shapes arrive to deliver vegetables, groceries, meat, ice, water, milk, fuel, hay, and grain.

The third train section arrives later with the remaining equipment/material wagons, and is unloaded and moved to the show lot (as described above). The equipment/material is placed inside the recently raised tents.

Finally, the fourth train section arrives with the ring stock, non-caged animals, and performers. They are all unloaded from the train, and the ring stock and noncaged animals walk to the show lot with their handlers. The performers are left on their own to make their way to their tents on the show lot.

With most preparations complete at the show lot, the workers and performers get ready for the circus parade that will wind its way along the town streets later in the morning (about 11:00 a.m.) to attract audiences for the day's two shows. The matinee performance starts promptly at 2:00 p.m. and lasts two and half hours. With the matinee show complete, workers and performers have a few short hours to rest and eat dinner before the crowds arrive at the evening show that begins promptly at 8:00 p.m.

Recognizing the importance of timeliness, all equipment/material for the show is prepared for movement (back to the rail yard) as soon as it is no longer needed for completion of the circus performance. For example, when a performer completes his or her performance, he or she returns to the dressing tent and the costume is removed, folded, and placed in the appropriate wardrobe chest. When the next chest is full, it is closed and loaded into the costume wagon. When all costume chests are loaded into the wagon, the wagon moves to the rail yard to await loading onto the appropriate rail car.

Even before the evening performance had started, workers had dismantled the cook house, dining, baggage horse, and smaller tents. The canvas, poles, and stakes were loaded into the appropriate circus wagon, which was then moved back to the rail yard. When the evening performance began at 8:00 p.m., the animal wagons were closed or covered and, along with the noncaged animals, moved from the menagerie tent to the rail yard. Then the sideshow and menagerie tents had their canvases lowered and bundled, their poles lowered, and their stakes removed. All the canvas, poles, and stakes were loaded into wagons and moved immediately to the rail yard—all before 9:00 p.m.

By the end of the evening performance at 10:30 p.m., all that remains standing are the Big Top and dressing room tents. (Upon exiting the Big Top evening performance, the audience was frequently disoriented due to the fact that the show lot was completely barren.) The workers complete the circus tear-down by removing the bleacher seats and rigging, taking down the Big Top and dressing room tents, and moving the loaded wagons to the rail yard.

Once the circus wagons and equipment arrive at the rail yard, the circus train master ensures that everything was loaded onto the appropriate train section. Second, he loads the wagons and equipment in the exact reverse sequence in which they were unloaded earlier in the day, minimizing unused space. For example, a 16-foot stable wagon, a 28-foot band wagon and a 16-foot calliope (musical instrument with large whistles) would be loaded on a 60-foot rail flat car, leaving no room to spare[4]. Finally, he ensures that the loading orientation for the wagons on each train section is either "poles to engine" or "poles to caboose," based on instructions received earlier from the advance man at the next town. Based on these factors, the train master instructs workers to harness teams to wagons and begin loading them onto flat cars. Other workers load baggage/ring stock horses and noncaged animals into the rail cars. By the time the train master loads the last train section, which usually leaves by 1:00 a.m., the Flying Squadron would have left two and a half hours earlier (by 10:30 p.m.), well on its way to the next town.

CIRCUS UNCERTAINTIES

Many uncertainties shadowed the circus as it traveled from town to town. Some were the result of Mother Nature and included weather (hot, cold,

4 Barnum & Bailey Circus, 1908 Train Loading Memorandum, Special Circus Collection, Milner Library, Illinois State University, Normal, IL

rain, snow, hail, ice, high winds, tornadoes, and hurricanes), fires, floods, and geographic terrain. Other uncertainties arose due to human nature, including quarantines (animals and humans), economic conditions, vendor reliability, equipment malfunctions, railroad equipment failure, and even robberies. Because circuses operated outside under the open sky, they were frequently subjected to one or more of these conditions. Often, any one (or a combination) of these conditions could conceivably halt or delay the circus from giving a scheduled performance or reaching its next scheduled destination on time. Because these circuses operated on a cash basis, any missed performances had an immediate financial impact. Too many of these conditions occurring over a short time span could completely shut down a circus for the season.

As the circus constantly faced these uncertain events, the goal of management was to have the enterprise's logistics function complete quickly and smoothly the thousands of daily tasks required to support movement of the circus and the presentation of performances. While circus management did not have the advantage of today's developed logistics concepts and technology, they clearly practiced the ideas of "swift and even flow" put forth by Schmenner and Swink (1998). The theory states that the quicker and more even the flow of materials/activities through any process, the higher the productivity/profitability of the enterprise. Swift and even flow argues for coordination of value-added activities and removal of bottlenecks (uncertainties). The following statement by John Ringling (1919, p. 183) highlights the recognition a century ago that a swift flow was a key element of the circus's logistics: "Our business is in constant motion. But beyond saving time, our object is to avoid mistakes."

And what is "circus logistics"? It is the management tasks of procurement, stowage, and transportation of personnel, animals, material, and equipment/facilities to support daily circus performances. Specifically, procurement focuses on acquisition of goods and services at the best possible total cost of ownership, in the right quality and quantity, at the right time, in the right place, and from the right source for the direct benefit of the circus. Stowage addresses the optimal handling, packing, and arranging of material and equipment for use on the show lot and during transit by the circus. (The term "stowage" is used here instead of "storage" due to the extreme short-term nature of these activities in the circus.) And transportation concerns the effective movement of circus personnel and property that meets the planned performance schedule and minimizes cost and time.

LOGISTICS PRINCIPLES

While the logistics function has roots in antiquity to support military campaigns, like those conducted by Roman legions 20 centuries ago, one sees today that an important cornerstone for a commercial enterprise is to be competitive and successful. Success depends upon planning and performing the logistics task effectively. To meet this performance goal, dozens of principles have been suggested by current practitioners and scholars under concepts such as "lean logistics" and Just in Time. While one might conclude that these are new ideas, we wish to demonstrate that a century ago, circus managers utilized these principles to attain a smooth and even flow to meet the enterprise's profit mission. While one could construct a long list of ideas that highlight the fact that some principles are timeless, we wish to focus our attention on the following principles:

■ ***Utilize an order lot size of one to minimize inventory.*** One can characterize circuses of the Golden Age as large entities moving across the landscape of America, devouring huge quantities of resources in their path. With 700-plus of performers and workers, and 300-plus ring and baggage horses, and several dozen caged and noncaged animals (including a dozen or more elephants) to feed, each day could focus attention on the need for food and feed.[5] For instance, Ringling Brothers required the following one-day food deliveries in Duluth, Minn., in 1908 (Apps 2006, p. 38): 90 gallons of fresh milk, 20 gallons of evaporated milk, 1,000 pounds of bread, 300 pounds of beef and pork, 90 pounds of butter, 45 bushels of potatoes,

[5] *After 1919, the combined Ringling Bros. and Barnum & Bailey circus traveled the country, feeding up to 1,600 people per day. (Hoh and Rough 1990, p. 143)*

18 bushels of spinach and young beets, 250 dozen eggs, 35 pounds of American cheese, 100 pounds of rice pudding, and 300 pies of 4 varieties.

This variety and quantity of food was sufficient to feed the circus staff for only one day. In fact, the circus used this food to prepare only the lunch and dinner meals, while the remaining food was stored and carried overnight by the circus to the next town to be used for preparing breakfast (Norwood 1940, p. 55). Upon arrival in the next town, the circus would receive a similar early morning delivery of food stuffs to feed everyone for the next 24-hour period.

Similarly, the circus received animal feed deliveries each day at a new town. The daily feed delivery for the combined the Ringling Bros. and Barnum & Bailey circus in 1919 included the following: 5 tons of hay, 20 tons of straw, 50 bushels of oats, and 600 pounds of bran (Norwood 1940). During some seasons, certain animals had special dietary needs. For example, when the circus had performing seals, their diet required fresh herring, which had to be shipped by rail daily to each town the circus was visiting. Consider the challenge of ensuring the delivery of fresh herring to the rail station in Muskogee, I.T. (Indian Territory) in 1895.

Obviously, the circus purchased more materials than just food and feed. For instance, it also received daily shipments of ice, wood, gas, kerosene, and wood shavings. Other material purchases were made on an ad hoc basis as a need would arise. For example, if the wardrobe department needed some fabric/lace or the blacksmith department needed some iron, nuts, and/or bolts, the purchasing agent would simply go to the local general store, acquire the necessary items, and deliver them to the appropriate employee.

Given the daily circus routine required by the circus, it is easy to recognize that no value was added by the stowage and moving of extra inventory. Indeed, the more excess inventory maintained, the greater the number of wagons and rail cars that had to be acquired, thereby increasing rail shipping costs, greater spoilage, and material handling expense. Thus, the circuses practiced (0,1) inventory ordering, resulting in a daily Just in Time inventory management system because variable inventory carrying costs greatly exceeded the frequent marginal ordering expense.

■ ***Track procurement and point of use delivery.*** Once a town's selection was finalized (usually three to four months in advance) on the circus travel schedule, the circus contracting agent would visit the town and contact local suppliers like grain wholesalers or national vendors like Armour Meats to provide food and feed supplies for the circus. Contracts would be signed with these vendors specifying the items, quantities, and quality to be delivered on a specific date. The contract would also specify the timing of the delivery and the requirement that the vendor meet with a circus representative for further delivery instructions.

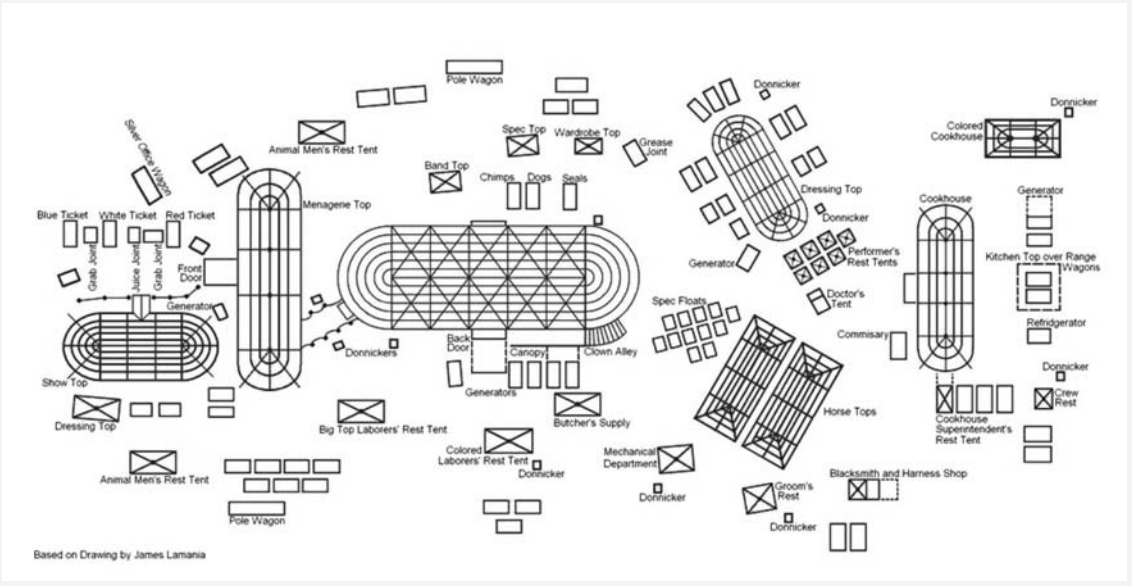
A day or two prior to the circus arriving in town, the advance man would contact all the local vendors to confirm delivery of the contracted items.[6] Any potential vendor delivery delays or nondelivery was the responsibility of the advance man to solve. It was his duty to identify alternative sources of supply.

As the local vendors arrived at the show lot each day with their dray wagons loaded with food, feed, ice, water, coal, gas, kerosene, and so on, they were not allowed to unload until the tent layout was completed. (Staley 1996, p. 32) Once management knew exactly where each tent was to be located and doorways oriented, the vendors were then instructed as to where to unload their goods. (Beal 1938, p. 62) Sometimes this meant several partial unloads, such as the hay, straw, and grain being placed at several different horse/animal tents and at the railroad siding for loading of feed into the horse and animal rail cars (McKennon 1977, p. 28). This, in part, reflected circus management's broader preference for minimizing the need for employee double or triple handling of materials and equipment (Norwood 1940, p. 3). This is similar to the lean and synchronous operating procedures employed by today's enterprises.

■ ***Position operational equipment to minimize flows and waste.*** The layout, or arrangement, of the circus resources (people, equipment/facilities, materials, and animals) on the show lot had a sig-

[6] *In the Ringling Brothers circus the cook house steward traveled ahead of the circus and selected the local vendors and signed food delivery contracts*

FIGURE 5: Detailed Example of Show Lot Layout



Adapted from "The Circus: The Next-Greatest Show on Earth is the Feat of Transporting the Ringling Troup," *Fortune*, Vol. 39, No. 7-9 (July 1947), p. 109.

nificant impact on the efficiency with which these resources could be "pulled to," "used," and then "pulled from" the lot. Rather than one or two large tents set up on a show lot into which all the circus resources would be placed, large circuses over time expanded the number of circus tents on the show lot to 20 or more. As shown in Figure 4, the Ringling Brothers circus had a several tents for support functions (such as dining and dressing) in addition to the performing tents of Big Top, the side show and the menagerie. Management recognized that it was more effective to organize the show lot according to function, and each tent was designed with a different size or shape to support its specific function. The variety of tents also provided management with flexibility to arrange them in a configuration that best suited the topography at each specific show lot.

For example, Figure 5 illustrates one show lot layout that highlights a number of important points. First, given the size of the show, 15 to 18 acres of space was required for this rectangular configuration. A lot with a square or 'L' shaped perimeter, or the presence of natural obstacles like trees, would need a different layout. Second, the performing activities on the left were separated from the "backyard" support activities on the right. Note that the customer traffic flow was confined to the left side, with a midway-side show corridor leading to the menagerie and Big Top tents. The backyard layout has facilities and equipment co-located to minimize adjacent movement.

In addition to the "functional layout" of circus tents on the show lot, the same precision of location (relative to the tents) was applied to all the equipment, tools, and so on removed from the wagons ("The Circus: The Next-Greatest Show on Earth is the Feat of Transporting the Ringling Troup," 1947, p. 133). For instance, in the cook tent, the stoves, food items and work tables were arranged in the same way each day. In the dining tents, tables and benches were arranged the same each day, and workers, performers, executives had assigned table seating. The cage wagons were placed in the menagerie end to end with their front wheels turned toward the side canvas—ready for horses to be hitched for hauling the cage wagons back to the rail station (Moffett 1895, p. 55).

Finally, the wagons full of materials and equipment were loaded and unloaded from rail flatcars in a specific order. At the beginning of each season, the railroad manager planned the number

of rail cars for each train section (at its peak in 1928, Ringling Bros. and Barnum & Bailey had four train sections with a total of 100 rail cars) and identified what wagons would be loaded (in sequential order) onto each flat car. (Hoh and Rough 1990, p. 137) The sequential wagon order for each flat car ensured that each car was fully loaded, possibly with a wagon overhanging each end by a few inches.

The assignment of equipment and animal wagons to flat cars was an important decision, since there were many wagons ranging in length from 6 to 55 feet. For example, the Barnum and Bailey circus had 121 wagons traveling on the first three train sections in 1908 (see Figure 2). The goal was to minimize unused linear space, since the railroad charged by the number of cars hauled. This assignment decision today would be know as the "bin packing problem," which is combinatorial NP-hard.[7] Generally, objects of different sizes must be packed into a finite number of bins of known capacity in a way that minimizes the number of bins used. Since it is NP-hard, the most efficient algorithms use heuristics to make assignments which, though very good in most cases, may not be optimal. While the simpler version of the problem assumes that the bins are the same size, the more complex packing problem has variable sized bins. For the 1908 Barnum and Bailey circus, both 50- and 60-foot flat cars were used (see Figure 2). Based on the linear feet of flat car space (2230 feet) available and linear footage of wagons (2,186 feet) of various lengths to be loaded, the circus attained a 98 percent stowage utilization—a very good performance using human judgment (heuristics)!

■ ***Design equipment to minimize setup and task times.*** Myriad stowage activities, both packing and unpacking, were crucial to the movement of the circus, but some activities were more critical than others. Of particular interest to management was the subset of critical path activities involving unloading of the circus train, moving the materials and equipment to the show lot, raising the tents, and setting up the equipment. Management gave special attention to these activities by developing specialized equipment and standardized operating procedures to perform these critical tasks.

All the materials handling and stowage equipment were typically owned by the circus with the exception of the train engines and cabooses (if utilized). This enabled the circus to design and build materials handling and stowage equipment to their standard specifications. The major materials handling and stowage equipment included rail cars, wagons, and containers (trunks, wardrobes, ice chests, cases, and more).

Several types of rail cars were used to move a circus including advance cars, flat cars, stock cars, coaches, and private (owner's) cars. Of most interest from a design perspective were the flat cars and stock cars. Flat cars were the most flexible form of circus rail equipment. Any wagon owned by the circus could be loaded onto one of the flat cars. The circus flat cars were designed to carry extra heavy loads and built especially low, with brake wheels and levers located on the side of the car rather than at the end. In addition, the ends of the flat cars had no obstructions over the end sills. This enabled the use of steel cross-over plates between flat cars to permit wagons to move the full length of the flat car section and, thereby, reduce the load/unload time. The flat car at each end of a flat car section was a run car fitted with additional hardware used to unload and load wagons. This hardware usually included a snubbing post and end slots for hooking the runs (ramps) for safe movement.

Stock cars were used to carry the baggage and ring horses, ponies, and noncaged animals such as elephants, camels, zebras, and giraffes. The baggage horse stock cars held 27 fully harnessed horses (reduced preparation time) standing side-by-side (tail-to-nose); the last horse boarded was the "wedge" horse. The horses were packed tightly (in the same sequential order) so they could not fall during transport. Each horse faced a built-in trough with water and hay. The bottom of the trough was a lid to the grain box. Prior to the train's arrival at the next town, a night watchman/helper walked the top of the baggage stock cars pulling the chains to open grain boxes so the baggage horses could feed prior to the morning

[7] *For a more complete discussion of the bin packing problem and solution methods, see Chapter 8 in Silvano Martello and Paolo Toth,* Knapsack Problems: Algorithms and Computer Interpretations, *New York: John Wiley & Sons, 1990.*

unloading. In addition, each baggage horse harness was attached by chain to a ceiling hook in the stock car so the horse would not have to carry the weight of the harness during the train trip.

Circus wagons were also custom designed to meet various tasks required for performance (for example, the calliope and grand band) and support (for example, the cook house and blacksmith). There is not sufficient space here to describe the design unique among the various types of circus wagons; however, each wagon required a differential design. For instance, the cookhouse wagons had stoves designed to easily deploy into preparation position once on the show lot. On the other hand, cage wagons had open bars on each side to enable customers to view the animals inside.

Finally, the design of containers such as trunks, chests, wardrobe boxes, cases, and so on was even more varied. Many of these containers were purpose built by each circus to aggregate and store smaller items and materials. As one example, the cook house had several dozen dish chests with built-in inserts for plates and tube sections for coffee cups. This form of containerization minimized breakage of dishes due to the roughness of the train rides and movement over dirt, gravel or cobblestone streets. The performer's chests were a specific design and limited to a standard size as established by the circus. (Beal 1938, p. 189) These containers were then loaded into larger containers (circus wagons) usually in a specific order and orientation to ensure that the wagon space was fully utilized.

Circus management gave careful thought to the stowage of its materials, equipment, personnel, and animals. This standardized materials handling and stowage equipment was combined with standardized procedures to minimize the time and resources required to perform the critical activities of unloading the rail cars and setting up the circus show lot. Such process standardization (they could do it only one way, given the materials handling and stowage equipment) clearly determined how the circus employees should perform their tasks and activities. Constraining how employees perform activities contributed to increased consistency and efficiency in operations, similar to the Japanese concept of poka-yoke that become popular in the 1980s.

■ ***Reduce/eliminate transit bottlenecks through lot splitting.*** The Golden Age of the circus in America is defined as the period when the circus moved by rail from town to town. Initially, the first circuses moved by rail on only a few rail cars. As the successful circuses grew in size, however, the number of rail cars required to move it grew proportionally. During the 1920s and 1930s, the combined Ringling Bros. and Barnum & Bailey circus required more than 100 rail cars. Linking this many rail cars together would create a train more than a mile long, making it unwieldy to handle over some track elevations and grades. Also, as the circuses expanded and the need for additional rail cars grew, it became impractical, from an efficiency and coordination perspective, to maintain the single circus train. Therefore, management began to divide the rail cars to form multiple trains. Each circus train was referred to as a "section," as shown in Figure 2, and was typically numbered one, two, three, and so on.

One primary reason for breaking the circus train into sections was the time required to load the entire circus onto one train. If a large circus waited until the end of the Big Top evening performance at 10:30 p.m. to begin tearing down the circus, moving to the rail yard and loading onto rail cars would have taken four to five hours; in that case, a single large train could not leave for the next town until 2:00 a.m. to 3:30 a.m. Such a late departure would limit the distance a train could travel to the next town since the circus needed to arrive at the next town by 4:00 a.m. to 5:00 a.m. so that the circus could be unloaded, set up on the show lot, and started (parade) by 11:00 a.m.

Additionally, the concept of multisection, phased train shipments enabled the circus to sometimes be in "two places (towns) at once." Management realized that all the circus materials and equipment were not needed on the show lot during the same time period. The cook house materials and equipment for feeding the employees were required on the show lot from 5:00 a.m. (start of breakfast preparations) until 5:30 p.m. (end of dinner preparations). In contrast, the Big Top materials and equipment were required to be on the show lot from 2:00 p.m. (beginning of the matinee performance) until 10:30 p.m. (end of

the evening performance).

Given this knowledge, management sought to smooth (and level) the workload bottleneck associated with tearing down, moving by rail, and setting up the circus across more hours of the day. Such a strategy of *overlapping* the show performances (11:00 a.m. through 10:30 p.m.) with appropriate activity *sequencing* the dismantling, packing, loading, transporting, (5:30 p.m. through 1:30 a.m.) served to level (smooth) the workload bottleneck and reduce the level of variation. By activity splitting and appropriate sequencing, the reduced variation enabled management to minimize the number of employees needed during peak workload demand, which is a frequently mentioned objective for today's operations managers.[8]

■ ***Minimize transit costs.*** As mentioned earlier, the circus would typically visit up to 150 cities and towns in a single season. It would move out of winter quarters in April, travel from town to town, and then return to winter quarters in November. Today, one would characterize this as the "traveling salesman" problem, where the typical objective is to minimize the distance or time travel. While this problem was formulated as early as 1937 (Danzig et al. 1954, p. 393), the objective for early circus managers was more complex than to minimize distance.

During the Golden Age, the national rail network consisted of hundreds of small railroads, each linked to another by transfer points. To move the circus train across the nation, or within a region, meant frequently moving the circus rail cars to an appropriate transfer point, then shifting the circus rail cars from one railroad to another. Each transfer from one railroad to another involved additional time and charges. Obviously, the goal of setting up a season's route was to visit towns where the circus could make the most money. But in grouping and sequencing these towns, consideration was given to maximize mileage over a single railroad track while minimizing the number of railroad transfers. Thus, the circus management was acutely aware of each railroad's track and the towns situated along it.

Rates for moving circus trains were established by regional freight rate organizations, which influenced circus logistics (Parkinson and Fox 1978, pp. 42-43). The rates were established in 5-rail car increments for trains ranging from 10 to 35 rail cars and in 10-rail car increments for trains ranging in size from 40 to 110 rail cars. Such a rate structure had a significant impact on how the circus determined the size of its circus train each season. Most circus trains were sized in increments of 5 or 10 rail cars. If an upcoming season's circus required 41 rail cars to load all its materials, equipment, animals, and personnel, efforts were made to review and shrink resource requirements to fit everything and everyone onto 40 rail cars. This reduced the rail travel cost since the circus would have been charged an additional "10 rail car cost" for the 41st rail car.

Another anomaly associated with the railroad rates was that rates were established according to the number of rail cars, not the overall length or weight of the rail cars. This is something that circuses used to their economic advantage. As a result, over time the design of circus rail cars incorporated added length. While most railroad flat cars were 50 feet in length, circus flat cars grew to a length of 72 feet in the 1930s. This enabled the circus to carry 44 percent more linear capacity per flat car at no additional cost. Thus, the circus was able to minimize overall railroad transportation costs by maximizing the length of its rail cars.

■ ***Employ flexible materials handling resources.*** The circus could be considered both high technology and low technology when it came to materials handling resources. The high-tech equipment employed by the circus was the railroad. The railroad system itself grew in significance at the same time the circus was expanding during its Golden Age. In fact, the railroad was the catalyst for the circus's

[8] *One line of inquiry pursued in the later part of the 20th century showed that breaking larger process/activity batches into smaller segments called "transfer batches" reduces flow time and improves performance. For more detail, see S.C. Graves & M.M. Kostreva. 1986. Overlapping operations in material requirements planning.* Journal of Operations Management, *Vol. 6, No. 3, pp. 283-294. Another avenue of investigation looked at precedent-related activities within project scheduling, where tasks are moved ahead or delayed to meet a finite set of resources required to complete the job. A review of this area is provided by W.S. Herroelen, B. De Reyk and E.L. Demeulemeester, 1998. Resource-constrained project scheduling: A survey of recent developments.* Computers and Operations Research, *Vol. 25, pp. 279–302.*

enormous growth during this time. The railroad provided circuses the flexibility to travel farther and faster than ever before. The flexibility in movement of circus resources was limited only by the rail track. By the end of the Golden Age, practically every community large enough to support a circus visit had been linked by rail. As noted in Figure 6, 743 different cities were visited during a 20-year period by the Ringling Bros. Circus, the Barnum & Bailey Circus or their combined circus.

At the other extreme, the circus employed low technology for the majority of its material handling activities. This lower technology consisted primarily of horses, elephants, and humans. Although these forms of materials handling resources might be viewed as relatively inefficient, they were extremely flexible—with the possible exception of elephants. Most employees, identified as "workingmen" by the circus, were largely responsible for the handling of materials and equipment onto and off the trains, to and from the show lots, and in support of the performances. In handling these materials and equipment, the workingmen were frequently supported by teams of horses and elephants. All heavy and burdensome materials and equipment handling was offloaded onto those animals wherever possible. One important capability of the horses and elephants was their ability to perform these material and equipment handling activities in all kinds of weather conditions. In particular, they could operate in sloppy, muddy, wet terrain, a distinct advantage to the circus since it needed to operate six days a week no matter the weather. Additionally, wagons were designed with extra hitch rings on the side. When a wagon was mired in mud, more six- and eight-horse teams would be attached to the wagon to pull it out. Mechanical tractors of the day could

FIGURE 6: City Frequency Visit for Ringling Bros. and Barnum & Bailey Circuses

	Barnum & Bailey Circus for 1910 to 1918		**Ringling Bros. Circus for 1910 to 1918**		**Ringling Bros. & Barnum & Bailey** Circus 1919 to 1929**	
Frequency of City Visited	Number of Cities	Percent	Number of Cities	Percent	Number of Cities	Percent
1	224	41.10%	205	37.41%	150	34.64%
2	111	20.37%	121	22.08%	78	18.01%
3	63	11.56%	88	16.06%	59	13.63%
4	69	12.66%	92	16.79%	49	11.32%
5	71	13.03%	39	7.12%	24	5.54%
6	5	0.92%	2	0.36%	18	4.16%
7	1	0.18%	0	0.00%	11	2.54%
8	0	0.00%	0	0.00%	15	3.46%
9	1	0.18%	1	0.18%	5	1.15%
10					6	1.39%
11					18	4.16%
Total*	**545**		**548**		**433**	
Average Cities Visited/Yr	144		144		128	
Average Show Days/Yr	189		172		190	

* For the 20-year period of 1910 to 1929, 743 different cities were visited by the three circuses. For the extremes: 321 cities were visited two or fewer times, while 57 cities were visited 15 or more times.

**Starting in 1919, the Ringling Bros. and Barnum & Bailey circuses were combined into one unit that traveled throughout the country.

Sources: Circus Route Sheets; Circus World Museum, Baraboo, Wisconsin; and www.circushistory.org.

FIGURE 7: Advance Advertising Example

Source: Collection of the John and Mable Ringling Museum of Art Tibbals Digital Collection, Sarasota, FL.

never meet this requirement.

Moreover, one would think that the circus bought the least expensive baggage stock available to serve as circus "horsepower." However, it was just the opposite—many circus owners were proud of their baggage stock and bought only the finest breed stock available. These animals pulled the wagons in the daily circus parade, and a matched set of 20 dapple-gray Percherons at the front of a decorated circus parade wagon was an awesome sight. Therefore, the baggage stock horses were a central part of the circus's performance, as well as an integral part of the materials handling function.[9]

■ ***Maintain continuous communication.*** Technology today has provided us with useful communication tools such as cell phones and the Internet, which have enabled modern enterprises to quickly, continuously communicate with customers, employees, and trading partners. This ability to "readily communicate" as an integral component to an organization's success was something recognized and well understood by circus managers more than a century ago.

As mentioned above, the circus was exposed to a wide range of uncertainties as it moved from town to town throughout the season. The time between when a town was added to the circus route and the show performed in that location could be many months, as noted in Figure 1. As seen even today, weather patterns can dramatically change the financial fortunes of a town, as Hurricane Katrina did to New Orleans, crippling potential revenue for an enterprise like the circus. Therefore, advance agents were always monitoring conditions, and if the picture looked bleak, a change in schedule would be made. For example, if a change in timing because of calamity necessitated

9 While we have noted here the performance and logistics flexibility of the baggage stock, similarly elephants and camels were also employed.

rerouting, then all trading partners were immediately notified that an adjustment was required. Personal visits, surface mail, and telegrams were employed to facilitate these communications.

Additionally, with preparations like arranging supply contracts occurring many months in advance of the performance date, it was important that all arrangements be executed as agreed upon to maintain a smooth and even flow. Therefore, as the promotional billing cars arrived one week to three weeks in advance to post notices of the coming circus, one of the billing staff would contact local vendors to confirm that prior arrangements were still in effect. Any deviation was quickly communicated by advance personnel back to the circus contract manager via telegram, and corrective action was initiated.

Finally, the circus owner's goal was to attract paying customers to the matinee and evening performances. The main communication tool was poster advertisements that would be displayed in windows, telephone poles, and billboards. In some cases, whole buildings would be covered (see Figure 7). As noted in Figure 1, at weekly intervals three weeks prior to the circus's arrival, bill cars would arrive at a town to literally plaster the town and surrounding area with notices of the coming circus. This three-week continuous poster barrage, coupled with arousing excitement at the rail yard during unloading and the morning parade, were the primary communication media tools used to announce to the public the forthcoming entertainment experience.

CONCLUSION

Perhaps foremost on the minds of all circus people during the Golden Age was the need for *constancy of motion*, which was fundamental to the circus's survival (May 1926, pp. 387-391). During the Golden Age, circuses operated on a strictly cash basis, with daily revenues consisting of ticket and concession sales. Daily expenses consisted of the food, feed, supplies, and transportation costs. If daily revenues did not exceed daily expenses, the circus could not continue to operate for long. Larger circuses such as Ringling Brothers and Barnum & Bailey usually began their season in Chicago and New York City, respectively, playing for two continuous weeks, hoping to build up their cash reserves before hitting the road. It was not uncommon for circuses to miss a number of daily revenue opportunities due to natural and human-made disasters and possibly "go bankrupt" (run out of cash) during the middle of a season. Therefore, the fear of bankruptcy was a great motivator for management and staff to focus on trying to maintain the smooth and even flow of the circus moving from town to town 150 times throughout the season.

The performance and movement of the circus required great *discipline* and careful executed *advanced planning* procedures; it was "one of the more highly controlled and organized of human activities" (Hoh and Rough 1990, p. 139). While circus management devoted considerable expertise in developing procedures and equipment to shorten the logistics time and effort required to support the performance and movement of the circus, there were, in fact, two objectives. The first was concerned with the effective procurement, stowage, and transportation of the circus to meet its performance schedule. This goal was to synchronize all activities into a smooth and even flow in the face of many uncertainties. The combination of specialized materials handling equipment, precise operating procedures, and job specialization all contributed to the circus operating as a "well oiled machine."

The logistics principles discussed here highlight the fact that what may well be considered new management ideas and procedures today were employed more than a century ago by creative, resourceful individuals in an industry where continuous and smooth, even flow were critical to success. John Ringling stated that "speed and pep" to entertain audiences and a desire to improve tasks, as noted by "I learned from others and I am willing to give them back the benefit" (Ringling 1919, p. 56), were important management concepts that affected circus logistics and working relationships.

The second objective was that many logistics tasks themselves had an entertainment value and were used in that manner. The performance of the critical path activities of unloading the rail cars and setting up the circus tents were themselves "something spectacular" for the public to

observe. It was not uncommon for the first circus train section to arrive in town before daylight to be greeted by thousands of local folks wanting to watch the circus unload and set up on the show lot. Circus management would have charged the public admission to observe this performance—if only they could have visually secured the rail yard and show lot areas. As promoted by P.T. Barnum, it was **"The Greatest Show On Earth."**

POSTSCRIPT

The information presented here was based primarily on sources that documented the Ringling Brothers and Barnum & Bailey circuses. They were the biggest circuses and industry leaders. Much of the above discussion, however, was common to all circuses of that era.

ACKNOWLEDGEMENT

The authors express there appreciation to James Patterson (Indiana University) and Morgan Swink (Michigan State University) for their constructive comments on an early draft.

REFERENCES

Apps, J. 2005. *Ringlingville* USA. Madison, WI: Wisconsin Historical Society.

Apps, J. *Tents, Tigers, and the Ringling Brothers.* 2006. Madison, WI: Wisconsin Historical Society.

Beal, G.B. 1938. *Through the Back Door of the Circus.* Springfield, MA: McLoughlin Bros., Inc.

Cincinnati Historical Society. *The Circus Colossal: Official Program of the Ringling Brothers and Barnum and Bailey,* Cincinnati, OH: Cincinnati Historical Society, 1919.

Danzig, D., R. Fulkerson and S. Johnson. 1954. Solution of a large-scale traveling-salesman problem. *Journal of the Operations Research Society of America* 2 (2): 393–410.

Fox, C.F. 1983. *Circus Baggage Stock.* Boulder, CO: Pruett Publishing Co.

Hoh, L.G. and W.H. Rough. 1990. *Step Right Up! The Adventure of Circus in America.* White Hall, VA: Betterway Publications, Inc.

Hubbard, K. December 8, 1923. Old Overland circus day. *Saturday Evening Post*, Vol. 196, pp. 36+.

Kelley, F.B. 1938. Secrets of the circus engineers. *Mechanix Illustrated*, Vol. XX, No. 4, pp. 35- 38 + 135.

May, E.C. 1926. Keeping the circus in motion. *Popular Mechanics*, Vol. 45, pp. 387-392.

May, E.C. July 1929. The Circus clings to the county road. *Popular Mechanics*, Vol. 52, pp. 66-71.

McKennon, J. 1977. *Logistics of the American Circus.* Sarasota, FL: Carnival Publishers.

Moffett, C. 1895. How the circus is put up and taken down. *McClure's Magazine*, Vol. V, No. 1, pp. 49-61.

Norwood, E.P. *The Other Side of the Circus.* New York, NY: Doubleday, Doran & Company, Inc., 1940.

Parkinson, T. and C.P. Fox. 1978. *The Circus Moves by Rail.* Boulder, CO: Pruett Publishing Co.

Ringling, J. September 1919. We divided the job—but stuck together. *The American Magazine*, Vol. 88, pp. 56-58+.

Schmenner R.W., and M.L. Swink. 1998. On theory in operations management. *Journal of Operations Management* 17 (1): 97-113.

Staley, J. March-April 1996. The circus steward: Part VIII. *Bandwagon*, pp. 28-34.

July 1947. The Circus: The next-greatest show on earth is the feat of transporting the Ringling troup. *Fortune*, Vol. 39, No. 7-9, pp. 107-113+.

August 18, 1908. Three circus trains are wrecked. *Bellingham Herald*, Vol. 17, No. 124, p. 1.

Thompson, W.C. 1905. *On the Road with a Circus.* New York, NY: New Amsterdam Book Co.

Willson, D. 1932. *Where the World Folds up at Night.* New York, NY: D. Appleton & Company.