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14. ABSTRACT

In 2009 and 2010, the Aerial Delivery function at Little Rock Air Force Base experienced periodic surges in training load demand that could not be met under the current supply chain. Critical to the training of aircrew on base spanning three Major Commands, this ultimately affected the Air Forces ability to provide Air Drop capability to the DoD. In light of this problem, this study was conducted and found no analysis of the supply chain or logistics process had been conducted. Subsequent analysis included manufacturing throughput, aggregate planning, seasonality, forecasting, supply chain ITV, labor and strategic customer-based partnerships.
After extensive data analysis and subject matter expert interviews, the project was able to clearly define the problem and found previous reports to Command level were in error. The production facility had excess & unused capability/throughput and was overmanned, forecasting timelines could be improved by 150%, existing infrastructure was sufficient and customers were double booking thereby artificially inflating demand data.
Results of the study include production capacity increase of 50%, increased aircraft service rate, improved supply chain ITV, increased supply chain agility, construction and labor cost savings and improved strategic partnerships.

15. SUBJECT TERMS
Air Drop, supply chain, little rock, heavy, containerized, jpads, logistics, forecasting, throughput, savings, seasonality

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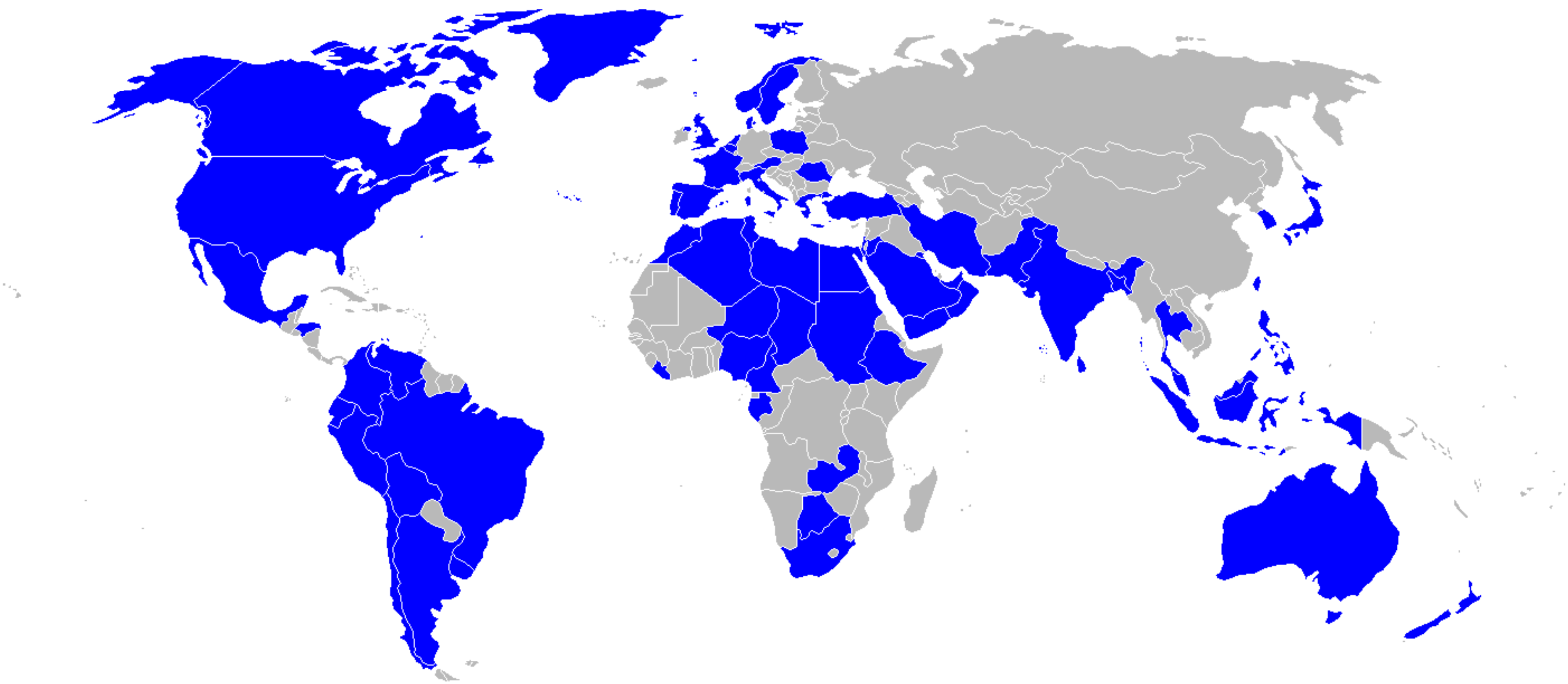

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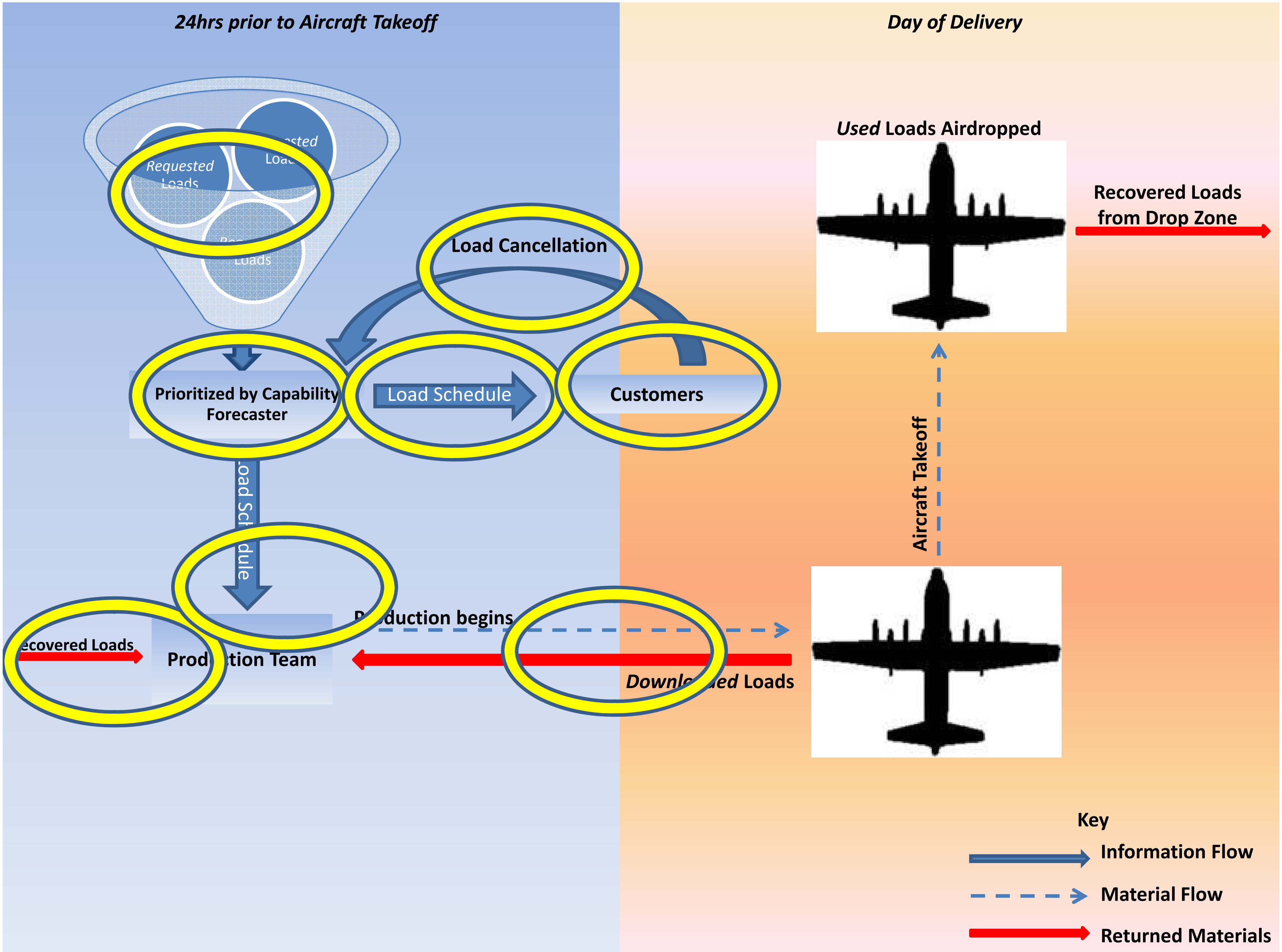


24hrs prior to Aircraft Takeoff
Day of Delivery
Requested Loads
Load Cancellation
Prioritized by Capability Forecaster
Load Schedule
Customers
Production begins
Recovered Loads
Production Team
Downloaded Loads
Used Loads Airdropped
Recovered Loads from Drop Zone
Aircraft Takeoff
Key
Information Flow
Material Flow
Returned Materials

StatTools (Core Analysis Pack)

Analysis: Regression

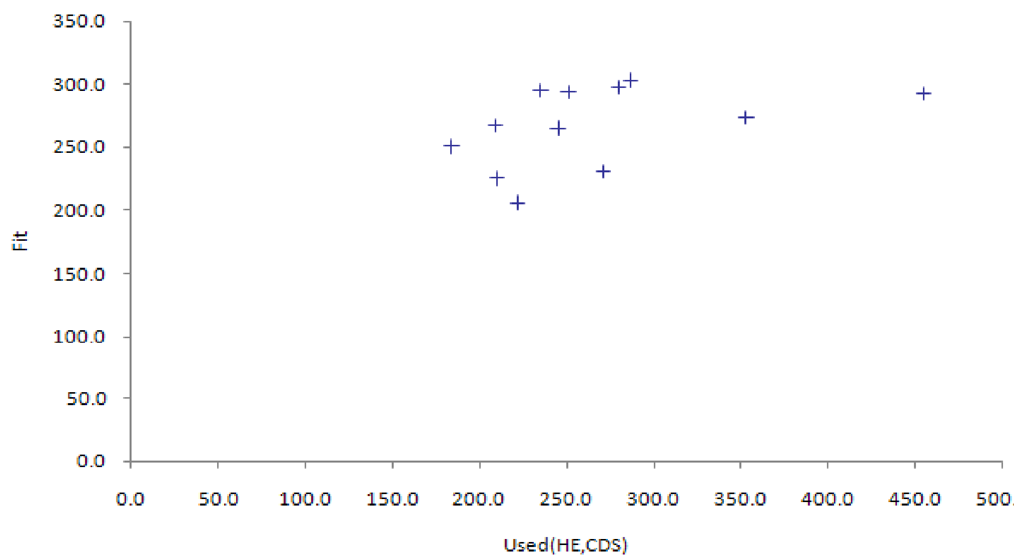
Performed By: Kaz

Summary	Multiple R	R-Square	Adjusted R-Square	StErr of Estimate
	0.4357	0.1899	0.1088	70.07671376

ANOVA Table	Degrees of Freedom	Sum of Squares	Mean of Squares	F-Ratio	p-Value
Explained	1	11508.20855	11508.20855	2.3435	0.1568
Unexplained	10	49107.45812	4910.745812		

Regression Table	Coefficient	Standard Error	t-Value	p-Value	Confidence Interval 95% Lower	Confidence Interval 95% Upper
Constant	310.739606	35.09753139	8.8536	< 0.0001	232.5374327	388.9417793
09 Precip	-6.618204647	4.323247092	-1.5308	0.1568	-16.25099946	3.014590165

Scatterplot of Fit vs Used(HE,CDS)



63%

42%

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The Redesign

What Went Wrong

- Failure to understand customer
  - Trying to control demand

The Fix

- Web-based system with built-in controls
- Create a customer managed inventory

The Findings

- Production facility overmanned
- Capacity inaccurately defined
  - Artificial bottleneck
- Abysmal forecasting
- Highly inaccurate customer demand
  - aprox. 10% products returned & 20% same day cancellations
- Aprox. 50% of base production capacity goes unused daily

Process Redesign

72+ hrs out
- 15 Heavy Loads Available
- 30 Containerized Loads Available

48-72 hrs out
- 12 Heavy Loads Available
- 25 Containerized Loads Available

24 hrs out
- 10 Heavy Loads Available
- 20 Containerized Loads Available

Improved predictability, scheduling, lead times, forecasting

Approaching Aircraft Takeoff Time

Benefits Captured to Date

Money

•$1.7M saved from HQ/AMC reconstruction contract

•$480K saved annually including POL and equipment repair costs!

•$200K approved for production line improvements and finished goods inventory holding area

Capability

•12 Mil. personnel now cross flowed between sections—Training course est.

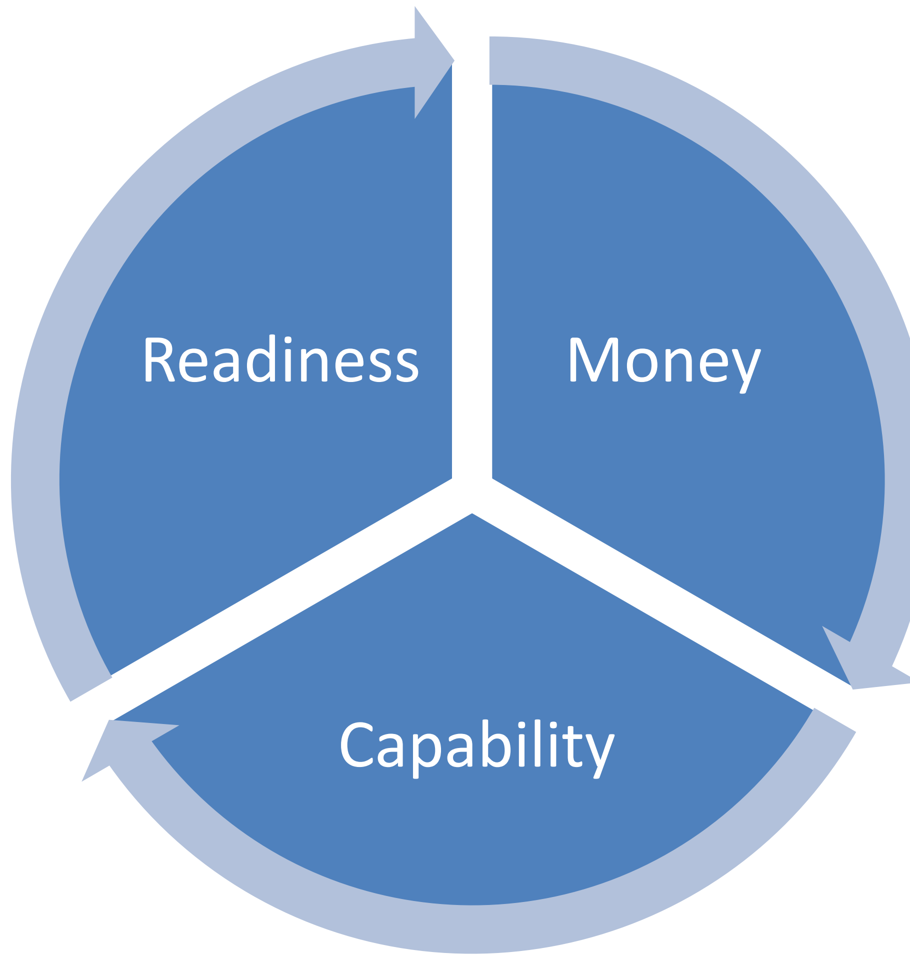
•Increased A/C handling capability from 4 to 6 hourly; bottleneck removed

•Newly approved contract for $700K toward drop zone facility(June 2011)

• improved turn times and drop zone presence

Readiness

• Production capacity increased 50%



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Questions?

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Optimized Aerial Delivery Process

EX801 APPLIED SYSTEMS DESIGN PROJECT

Kazimir Kostrubala

1 Jan 2011

Executive Summary

Throughout the past 50 years, the C-130 "Hercules" aircraft has proven invaluable to the Air Force by successfully fulfilling a variety of tactical roles, to include aerial delivery, aeromedical, and humanitarian support. Additionally, its flexible design allows for rapid reconfiguration in response to many types of payloads, not only increasing its efficiency and utility but effectively enabling a timely logistic response to an asymmetric demand. Home to the largest C-130 training base in the DoD, Little Rock Air Force Base is ground zero for the successful implementation of a critically needed platform in our current theatre of overseas operations. Subordinate to three distinctly different commands on the Air Base, the squadrons responsible for this training compete on a daily basis for a pool of limited resources; at the heart of this training is aerial delivery.

This report examined the supply chain and additional logistic processes associated with this training and found them inefficient and inadequately responsive to today's operations tempo. The lack of a standardized and synchronized approach to the current process has resulted in a bullwhip effect felt throughout the base which is captured in the large amount of operational waste observed by this study. The consequence of this effect is a decreased readiness posture throughout the base due to limited forecasting horizons and improper and untimely use of personnel and assets. As information pertaining to this process was also found to be inaccurate and delayed, the supply chain has grown needlessly robust in an effort to manage the uncertainty felt by all organizations. Most importantly, these problems caused the supporting logistic process to lose its agility, the result of which is unmet customer demand and stalls in training.

This report proposes the creation of a new system, capable of removing the artificiality and waste seen in the current process and improving readiness through elevated logistic agility. Centered around the value of real-time information and visibility, the proposed process would reduce uncertainty, reduce the impact of causal methods on forecasting and enhance decision making for all levels of leadership associated with the process. Strategic partnerships would also be created as a result of creating a hybrid push-pull supply chain, managed by the customer and encouraging lateral dialogue at various levels

between the three commands. Any of the gains mentioned will have a direct impact on the USAF's ability to deliver and sustain support to the warfighter.

EX801 Applied Systems Design Project Course
Kazimir M. Kostrubala

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Introduction

With a history spanning nearly three decades, the production of airdrop training loads at Little Rock Air Force Base is by no means a new logistics process, with demand rate and load type bearing the brunt of variability overall. This variability in load stems from the need to simulate multiple real-world conditions and commonly includes heavy training loads, containerized delivery systems (CDS), tactical training bundles (TTB) and most recently, Joint Precision Air Drop Systems (JPADS). These loads are subsequently packed onto a C-130 and flown over a drop zone to be released at a preplanned point in time and space satisfying training requirements belonging to the aircrew aboard. Once released, personnel and machinery belonging to the 19th Logistics Readiness Squadron are standing by to observe and recover the dropped loads, eventually re-inserting them into the load production process on base some twenty miles away. This cycle of building, delivering and recovering these training loads typically occurs Monday through Friday on a 24 hour basis. Materials, manning and time associated with each type of load also varies (attachment A).

User demand belongs to eight different flying squadrons falling under the three separate Major Command structures of Air Education and Training (AETC), Air Combat (ACC) and Air Mobility (AMC) Commands. The training requirements for each squadron and command vary and the ad hoc development of a system responsible for the scheduling and prioritization of these loads throughout the base resulted. Projected demand for the production of loads is captured roughly twenty-four hours ahead of aircraft departure time; prioritization of delivery is also performed at this point. If equal training priorities exist between squadrons, those under Air Education and Training Command will be served first followed by the scheduling of all others on a first come first served basis. Influenced by asset availability, maximum production throughput and mission importance, this system has remained relatively unchanged since the early 1990s.

Until this project, a comprehensive logistics-based analysis has not been completed on the airdrop process at Little Rock. Considering increases in the demand for airdrop capabilities in theatre and decreases in home station manning, the ability to clearly define and refine this process for today's environment is warranted. This report outlines the former process in further detail, discusses current redesigns and future improvements.

The Former Process

The start of airdrop demand generation begins with the need or generation of a training requirement for any of a number of individuals aboard the aircraft, whether it's a student, loadmaster or pilot. Across the base, these requirements are monitored and managed by the Aviation Resource Management Shop (ARMS) associated with each squadron. Each ARMS is responsible for ensuring the training needs of their squadron meet the requirements outlined for their command and also publish the currency requirements for all members of their unit via Excel document. The common name for this document, as it pertains to the member, is the Individual Training Summary (ITS) and it's this document that drives the scheduling of flying missions throughout all squadrons on base. At this point, it's important to define the two types of schedules and associated schedulers we're concerned with as we define the process; pilot and loadmaster.

Scheduling

The pilot scheduler is a rated officer residing in each squadron who uses the ITS to schedule sorties and accomplish various training requirements. On Wednesdays, each pilot scheduler from the associated squadrons will build this requirement-based schedule and place it into a mission planning program called the Global Decision Support System 2 (GDSS2). This system consolidates and forecasts entered operations from Monday through Sunday of the following week. To ensure proper coordination and to resolve issues, all pilot schedulers from these squadrons will meet the following day and review the schedule. Final changes are incorporated and the schedule is published Thursday afternoon. This published schedule is what is commonly referred to as "The Bluelines" on base. Also of note, GDSS2 does not show the load demand associated with the flying missions; enter the loadmaster scheduler.

The loadmaster scheduler is a non-commissioned officer responsible for training requirements specific to the aircrew in much the same way as the pilot scheduler is responsible for pilot training. Whether generated from a training book or ITS, the loadmaster scheduler must ensure various training requirements are met for those enlisted members within his/her unit. It's with the loadmaster scheduler that load demand data is first generated and submitted to the supporting organization to source. From a supply chain perspective, the loadmaster scheduler is our first true customer of the process. Based on the type of training needed and the availability of an aircraft mission as published in the Bluelines via GDSS2, they will submit a request defining the type and quantity of load to be built. This request will flow to the Aerial Operations Flight, an entity within the 19th Logistics Readiness Squadron, responsible for the production of loads. Most typically, the request will fall under one of several categories.

Load Categories:

Heavy Load: the largest commonly built load, used to simulate larger and heavier airdrops, e.g. vehicles, rolling stock.

Containerized Delivery System: a medium-sized load which simulates commonly re-supplied expendables, e.g. foodstuffs, ammunition.

Tactical Training Bundle: the smallest commonly built load, used to simulate personnel, i.e. paratroopers.

Joint Precision Air Drop: this is not actually a specific load type simulation but a technological device attached to a load; aided by the GPS and computer-based airborne guidance unit (AGU), this device assists in controlling the parachute upon deployment thereby guiding the load to the intended target area with additional accuracy.

Research shows that these requests are defined by the loadmaster scheduler in each of the flying squadrons, typically at different intervals; however the sourcing of the loads to Aerial Operations flight takes place at 0800 for missions the following day. Most commonly and for example, a loadmaster scheduler will define his airdrop needs on Monday and submit them by 0800 Tuesday to Aerial Operations Flight for a Blueline mission on Wednesday. Once Aerial Operations receives the requests from all Squadrons loadmaster schedulers via email, an individual called a capability forecaster will consolidate the requirements of quantity and type and level that against maximum production capacity and prioritize delivery according to specific guidelines if demand exceeds this value. Once this step is complete, the resulting load schedule is sent back to the loadmaster schedulers and the production process of airdrop loads begins within Aerial Operations Flight. There are several important differences observed between the pilot and loadmaster schedulers as it pertains to the scheduling process. The most notable is forecasting. Although it's common for loadmaster schedulers to know the training currency and requirements well in advance, the scheduling of load type and amount occurs only one day in advance as opposed to the weekly forecast established by the pilot schedulers. This timeline is represented in figure 1.

Production Process and Capacity

One of the initial steps of this project was to accurately measure and define the production process within Aerial Operations Flight. This process is capable of building all load types and consists of three main stages: pre-production, production and post-production. Each stage takes various times to complete but not all steps within each stage are accomplished daily. For example, it takes almost 24 hours to complete the pre-production phase by building the platforms needed to create certified loads but once completed, the platform is reusable and has a predictable lifespan. In order to account for the level of impact non-daily tasks and drop zone travel times have on the production process, a "realized hours" metric was established. This metric tells us how much time it takes one individual to produce one of each of the most commonly requested items: one tactical training bundle, one containerized delivery load and one heavy load (attachment A). Currently there are three overlapping, eight-hour shifts responsible for the entire process; the production phase however is only accomplished between 7am and 4pm.

The production area within Aerial Operations Flight consists of two main areas: floor space and rolling lines. Floor space is used for the inspection and packing of parachutes that will eventually be rigged to the loads. The two rolling lines run the length of the building and serve a purpose very similar to conveyor belts in an assembly plant; trained riggers are spaced at different intervals down the line tasked with completing specific assembly steps before moving the load to the next station. As previously mentioned, certification steps are needed at three specific build points along the line and the load cannot proceed without being certified per regulation. If an error in the rigging process is found, the rigging supervisor responsible for certifying the load will either assist in the correction or ask the task to be repeated before returning for a second inspection. Except in the rare case that a structural weakness is discovered, loads are not returned to the beginning of the line.

Phases of Production:

Pre-production: In this phase, raw materials and labor are used to construct platforms and shock-absorbers for each load; a limited lifespan is associated with this multi-use product and varies considerably according to environmental and other uncontrollable conditions. Platforms and shock absorbers will be periodically rebuilt as needed and this phase is accomplished on floor space, both in the main production building and a building adjacent. This stage accounts for approximately seven percent of actual (realized) daily labor time.

Production: In this phase highly skilled labor will pack and rig the appropriate parachute(s) to each load; several certification steps are implemented to ensure proper specifications are upheld. The certified load then waits in inventory before delivery to the aircraft. This stage accounts for approximately 66 percent of actual labor time and is predominantly accomplished on the rolling lines. Of note, there is no separate inventory space for completed loads; all loads remain on the lines until picked up by a forklift to be delivered.

Post Production/Recovery: This phase not only includes labor on the drop zone responsible for the recovery of dropped loads but also the transportation time to and from the base. Two hours was established as the mean time it takes to move the team of personnel and their equipment to and from the drop zone (round trip) on a daily basis. Exact measurement of this phase proves difficult as the number of personnel placed on a recovery team may vary, training requirements are the predominate reason behind this variability. To simplify this, subject matter experts agree that the average number of individuals allocated to this phase is three. This stage accounts for 27 percent of actual labor time.

Capacity: Most likely a product of unpredictable manning (driven by deployments) and transitional leadership, the perceived production capacity oscillated throughout the years. There are no records prior to 2007 that established capacity and/or throughput. Since that point in time, the Aerial Operations Flight has published a maximum production capacity of ten heavy loads and twenty four containerized delivery loads daily. Upon further analysis and interviews, this number was found to be highly subjective, derived from a combination of factors including manning, equipment, training, and physical assets on hand. Joint Precision Air Drop Systems and tactical training bundles weren't counted toward the production process and were accomplished "as needed." Although this approach appeared to yield a degree of flexibility for the supporting organization, it actually created a false cap on production, causing inflexibility; until this project, no discernable, research-based method had been established to measure maximum production capacity.

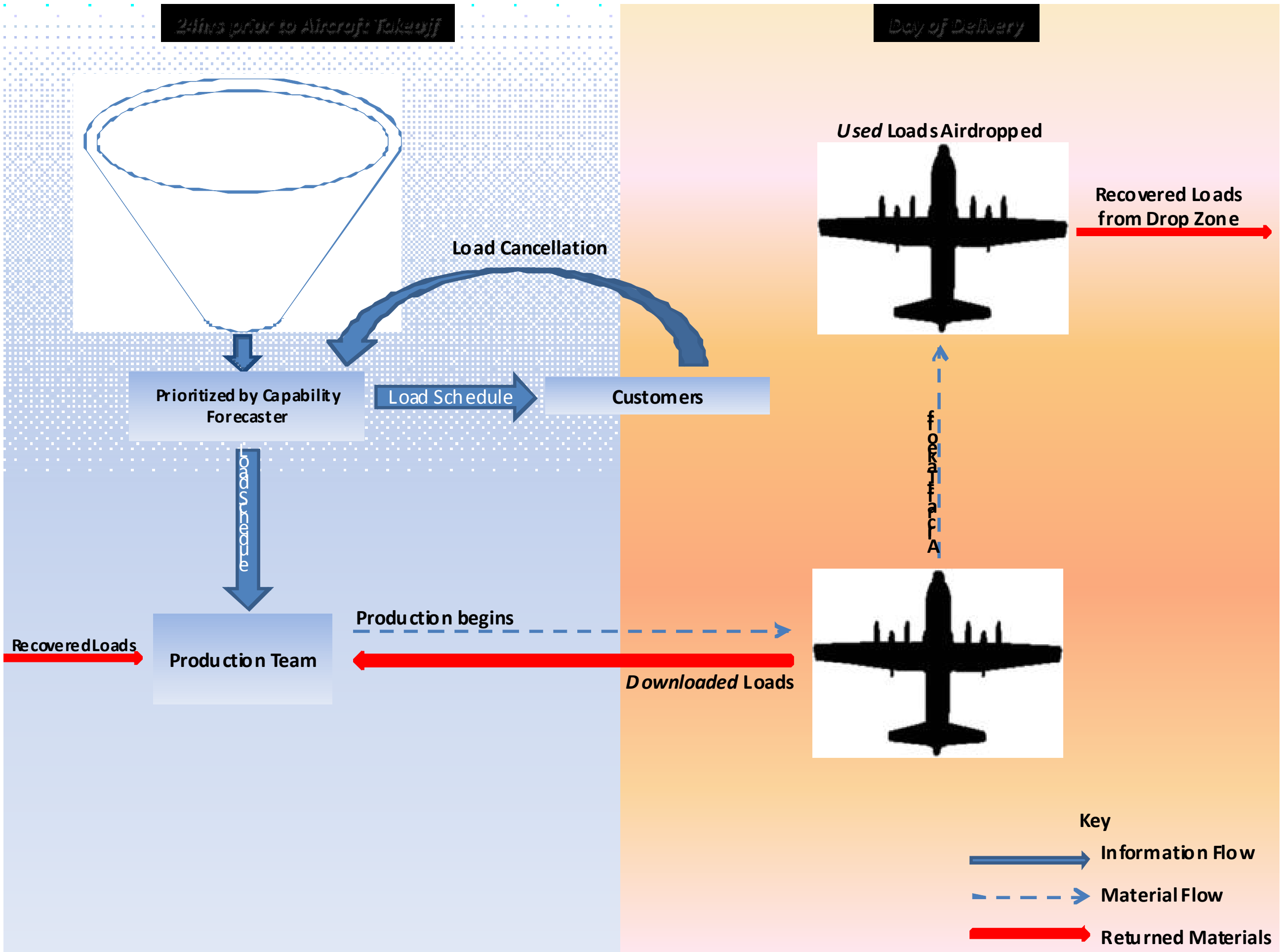


Figure 1: Diagram of the Former Process

Problems with the Former Process

Unused labor hours: tied to the unpredictable and commonly low demand rate, labor hours vary and the collected data shows a large amount of wasted man hours (attachment A).

Unpredictable demand: as seen with the 2009 historical data, a high degree of demand variability exists resulting in inefficiencies and loss for both supplier and customer (attachment B). Several times a month demand would spike to over 100% from the previous day and monthly demand averages are observed to grow and contract by as much as 30%. This variability artificially inflates the supply chain beyond what's practically needed to meet customer demand the majority of the time.

Non-standardized load forecasts and scheduling: highly inaccurate forecasting exists as well as inefficient scheduling (attachment B); this leads to an inefficient and weakened readiness posture. Graphically represented by figure 2, loadmaster schedulers are forecasting and scheduling a much greater amount of loads than what is requested to be loaded the day of the mission. As the supply chain is directly related to the training and certification of loadmasters, this inaccuracy is also assumed by the base's leadership when making decisions associated with status of Aerial Delivery training. This inaccuracy further prevents various logistics resources in the supply chain to be used elsewhere on base, constricting the responsive posture.

Unused capability: approximately 50 percent of the production capacity goes unused daily (attachment C) or stated another way, our customers could request twice as much. Customers have repeatedly called for an increase in capability but the historical data does not corroborate their need.

Decentralized and delayed demand information: at first glance, demand information appears "centralized" when it arrives at the capability forecaster but that perspective of centralized information would only be sufficient if our concerns as a base center on prioritization. Besides the duty of prioritizing loads, the capability forecaster is not an actor within the supply chain but a relay. Information is not shared between customers until prioritization and scheduling occurs. Real-time data is not available throughout the process and the opportunity for conflict resolution is constricted or avoided as scheduling data returns to the customer too late for plausible reaction.

Unmet Customer Demand: surges in demand periodically occur that cannot be currently met. The "10 and 24" threshold forces an inaccurate bottleneck within the process adding to operational waste. Simply put, the 10 and 24 threshold was enacted to limit the negative impact demand spikes place on the supply chain. This threshold was not only inaccurately defined but also ineffective pursuant to its purpose: a deterrent to demand spikes. Analysis shows this artificial cap encouraged loadmaster schedulers to cancel loads that could have been produced and delivered but also created a backlog of demand which ultimately manifested as a demand spike exceeding total capacity. Additionally, high levels of leadership from the supported commands will be notified if the Aerial Delivery Flight can't meet these spikes in demand. This will frequently cast a negative light on the production team and has caused several "knee-jerk" reactions leading to further inefficiencies. Some of these reactions include the generation of facility surveys, temporary increases in personnel and labor hours or cyclical shift changes.

Process Analysis

Redefined Capacity

One of the largest contributing factors to process inefficiencies was poor conclusions drawn from accurate data. This factor was first noticed within Aerial Operations Flight. Concerns from the production team responsible for the building of loads included manning and capacity. Specifically, it was stated that the production team was undermanned and demand was in excess of capacity. To address these concerns, this project initiated a study to assess the aggregate planning process, manning levels, define daily throughput and the maximum capacity of the facility.

Under the then current assumption that production manning levels were centered around producing 10 heavy and 24 containerized delivery loads daily, this study found a variable work hours model had been adopted within the aggregate planning construct. A subcomponent of the Chase strategy where a firm strives to match demand and capacity period by period, this model's greatest advantage is flexibility. Considering the short but frequent interruptions to the production team, reconfiguration limitations due to facility size and materials and the variability in product type and demand rate, the approach of varying work hours to meet demand was found optimal for labor conditions on site. The production team lead would balance customer demands with training requirements and other military duties for his team and schedule labor hours throughout the 24 hour horizon. If forecasting could be improved, components of a level strategy, where steady production and labor hours in effect, may be adopted. Additionally, this study determined the production team to be 10% overmanned pursuant to the production of the previously published 10 and 24 daily loads (Attachment A). Maximum daily production capacity was also redefined; facility size and asset availability were studied for potential bottlenecks and constraints and it was found that capacity measurements prior to this study did not include the physical plant or on-hand asset availability. Until this report, throughput had only been determined as a factor of manning and remained unnecessarily constrained. With this new data and the

10% manning surplus, daily production was calculated to reach 15 heavy and 30 containerized loads as opposed to the "10 and 24" previously published. The most significant finding however was the underuse of Aerial Operation's production capability.

In an effort to accurately define customer demand levied on the production process, the historical load demand data of 2009 was studied. The data collected contained all heavy load, containerized load and tactical training bundle requests received by Aerial Operations from the eight flying Squadrons throughout the 240 working days observed on the base (attachment B). The data received was stated as monthly totals for each type of load request and captured three categories.

Load Data Categories:

Loads requested: load requests generated by all loadmaster schedulers and received and annotated by the capability forecaster within Aerial Operations Flight.

Loads loaded onto an aircraft: the actual number of loads delivered to an aircraft before takeoff the day of the mission. The difference between this number and "loads requested" captures cancelled requests from customers received since the original request the prior morning.

Loads downloaded from an aircraft: loads that are downloaded from the aircraft intact. This measure indicates aircraft that flew their mission but did not drop their loads or missions that were cancelled before takeoff. This does not include "tail swaps" or loads moved from one aircraft to another but only loads that physically return to Aerial Operations Flight for the remainder of the training day.

As the data was analyzed, several significant trends became visible:

As a monthly average, heavy and containerized load requests did not exceed the previously published production capacities of 10 and 24. Non-working days were removed when calculating the following daily averages:

- Averaged daily heavy loads requested: 8.69
- Averaged daily CDS loads requested: 14.93

There were large variances between requested loads and what actually was placed on the aircraft the following day:

- Averaged daily heavy loads loaded onto aircraft: 6.65
- Averaged daily CDS loads loaded onto aircraft: 11.33

The measurement of downloaded loads, although not significant in amount, did allow for the elimination of a truly uncontrollable variable in the process and necessitated the creation of a new category in the analysis: Load Type Used. This category removed the uncontrollable variable of maintenance and in-flight emergencies by subtracting downloaded loads from the "loaded" category. Therefore, analysis of the remaining data could better reflect areas of improvement for the two predominant trends noted above. Key questions: as a result of this analysis, were our customers stating they wanted higher capacity but not asking for it and furthermore, why were they cancelling over 20% of their orders throughout the year?

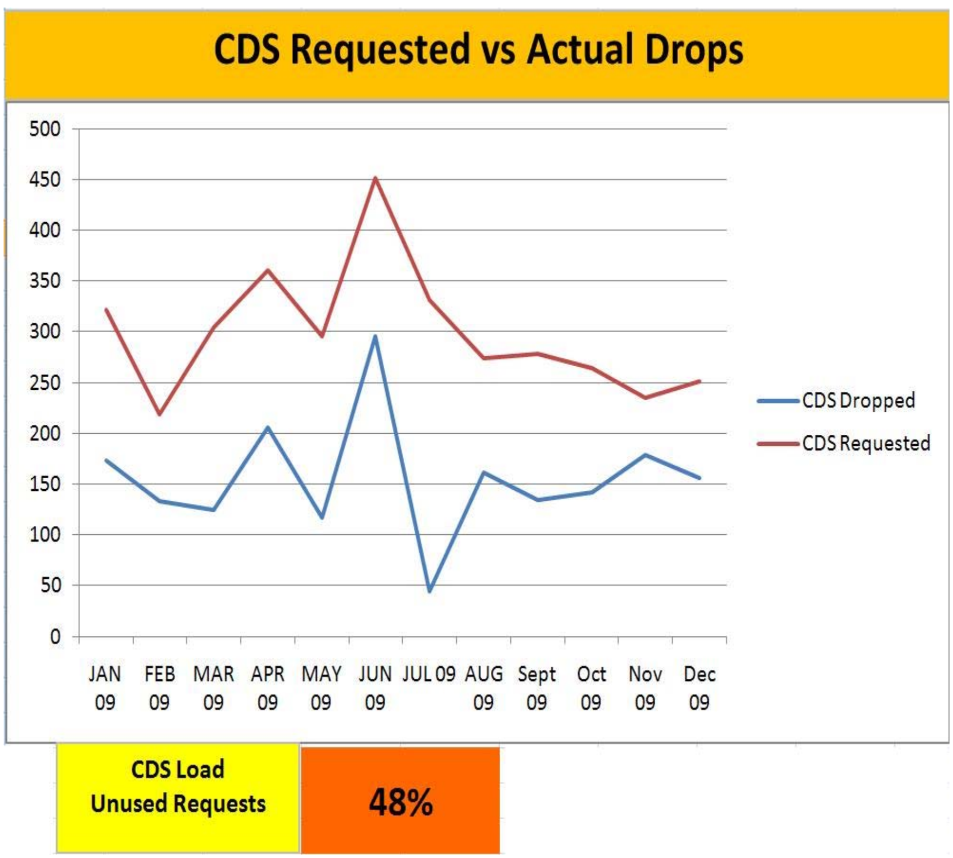


Figure 2a: Requested vs. Used

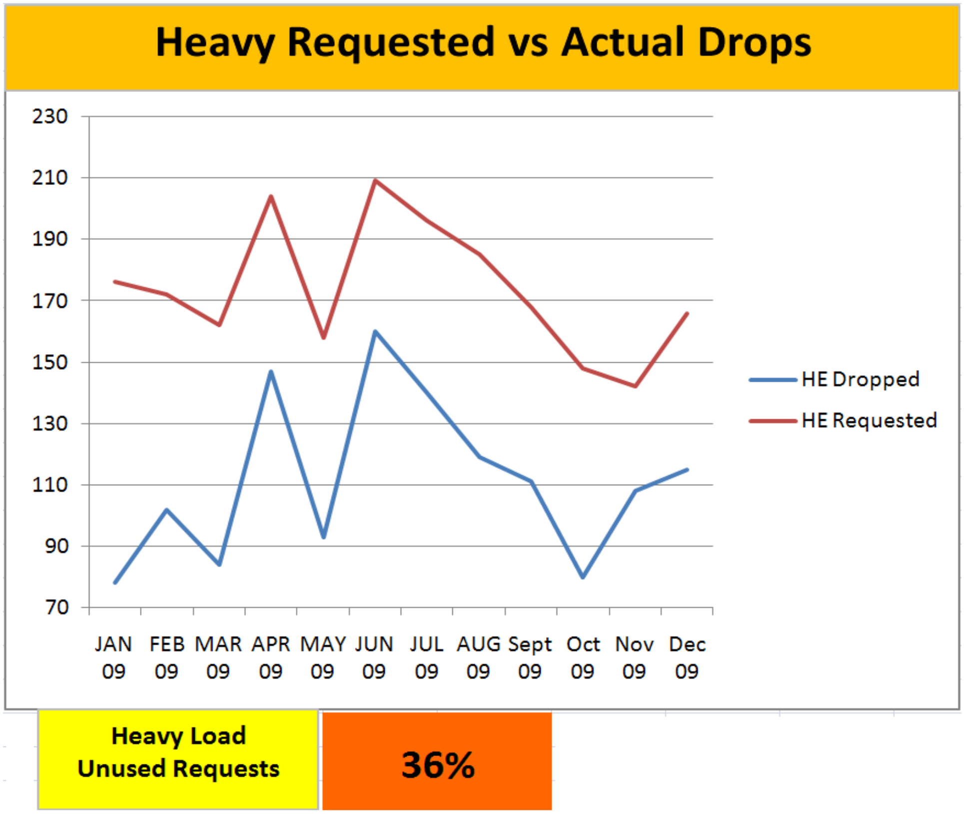


Figure 2b: Requested vs. Used

Capacity Shortage Perception

As loadmaster and pilot schedulers from the eight flying squadrons were interviewed, it became clear that the majority of the organizations had concerns about Aerial Operation Flight's ability to meet desired capacity. The definition of this desired capacity varied per squadron but the perception that a significant portion of demand was going unmet existed throughout each squadron of the three commands. Although this consensus directly contradicted the historical demand data for the year, the question of why it existed remained. Aerial Operations Flight's Records Management Shop did not maintain records of requests exceeding the 10 and 24 capacity, it fell to the customers to provide this data for analysis. Unfortunately, not all customers could provide this data. Some information was provided by the two squadrons within Air Education and Training Command. According to their records, their demand exceeded the 10 and 24 capacity threshold approximately 10% of the time and in nearly all cases, heavy loads were the desired platform; excess demand typically fell within the 11 to 15 range. Additional interviews of personnel within Aerial Operations Flight's Data Records Section agreed with the assessment that requests exceeded stated capacity approximately two or three times per month. As analysis continued it stood to reason that demand for excess capacity was not as large or as frequent as many customers thought. It was not however a non sequitur; enough evidence was present to demonstrate a need for added production flexibility and this desired increase in production rarely exceeded the newly established capacity of 15 heavy and 30 containerized loads. The follow-on question became: how can we add additional flexibility and capacity into the supply chain when customer demand is met 90% of the time and demand forecasting is extremely difficult? This question will be answered in the following pages.

Load Cancellation Root Causes

Answering why 20% of load requests were cancelled on a daily basis proved more difficult. One of the most common responses from the loadmaster schedulers was related to weather as a result of what's called an "unrecoverable drop zone." In simplest terms, an unrecoverable drop zone occurs when there is or has been too much rainfall in the immediate area for loads to be recovered properly. Unrecoverable drop zones are determined by the load team on site. In the hopes of providing a forecasting tool capable of better balancing the supply chain, a seasonal analysis was conducted (attachment D). Precipitation data was collected from the National Oceanic and Atmospheric Association over the past 34 years for the county in which the drop zone is situated. This precipitation data was averaged for each month and compared to the monthly precipitation data from 2009; as expected 2009 proved to be one of the wettest years on record and provided an exceptional metric for seasonal analysis.

By comparing this precipitation data to the amount of "used loads," "loaded loads," and "requested loads" several possible conclusions could be reached.

Seasonality-Based Conclusions

Seasonality Influencing Used Loads: During the wettest months of May, July, October and December, there appears to be an inverse correlation between rain amount and loads used, i.e., the more precipitation, the less loads used (dropped) on average. The converse however was not observed, i.e., the drier the month on average, the more loads used.

Seasonality Influencing Loaded Loads: No predominant trend was observed in relation to precipitation and the amount of loads that actually were delivered to aircraft. June and April received higher average deliveries whereas less than average loads reached aircraft during February and March.

Seasonality Influencing Requested Loads: The months of April, June and July experienced the highest amount of customer requests although there was no clear correlation to precipitation. Clearly, July was one of the wettest months on record during 2009 and June was one of the driest.

As seasonal analysis does not necessarily indicate the *specific* cause of the seasonal influence, i.e. precipitation, regression analysis was then conducted in relation to weather related cancellations. As tactical training bundles may be dropped regardless of weather, they were removed from the analysis to ensure only pertinent data capture. With precipitation set as the variable against used loads, the completed regression analysis yielded an R-Squared value of .1899; simply put, if we were to assume that precipitation affects the amount of loads dropped in any given month, we'd be right about 19% of the time according to the model (attachment E).

Although the thought that weather and the consequent "undeliverable drop zone," was no longer a strong influencing factor, the seasonal analysis yielded other interesting observations. It was clear that in the months of April, June and July there where higher than average requests and resulting loads loaded on aircraft, signifying a general increase in customer demand and operations tempo during these months. Another interesting observation occurred during the months of August, November and December. During these months, the average amount of load requests from our customers and loads arriving at the aircraft were some of the lowest throughout the year, yet it was during these three months that loads were dropped unto the drop zone (used) in a higher than average frequency when compared to the rest of 2009. Although less than average precipitation fell during August and November, December nearly tripled its average annual rainfall and became a strong argument against the "unrecoverable drop zone" theory being an influencing factor.

If precipitation and maintenance were no longer strongly influencing the bases' ability to efficiently complete airdrop training, what made these three months the most efficient in 2009 and furthermore would answering this question provide the sought solution to stymieing load cancellation? Analysis continued toward this end and it became increasingly clear that the primary reason for load cancellation was a product of customer uncertainty and the lack of real-time information in the supply chain; in short, they were overbooking.

Suggested Improvements

Understanding the relevant influences upon the supply chain is instrumental to improvement for both the supported and supporting organizations. One of the most important observations to surface from this study is found in corporate America as well: the inability to truly control customer demand. Removing the problems from the former process however is still completely attainable through the creation of a computer-based real-time supply chain in the new form of customer managed inventory. This system would be web-based and managed in much the same way as the current process; however several improvements would be made:

Centralizing Demand Information: although demand information currently funnels to the capability forecaster, this is not truly centralized demand as our customers and producers are not able to see this demand throughout the supply chain as requests are generated. Once located on the web, the delayed data problem experienced with the former process will also cease as real-time demand information can be visible and acted upon in a lateral fashion. Requests would be tied directly to the customer requesting the data, allowing the customers to resolve issues amongst themselves within a much larger window. In this sense, information becomes centralized across the entire supply chain via a new consolidated data stream and adds flexibility and responsiveness for both the customer and producer (figure 3).

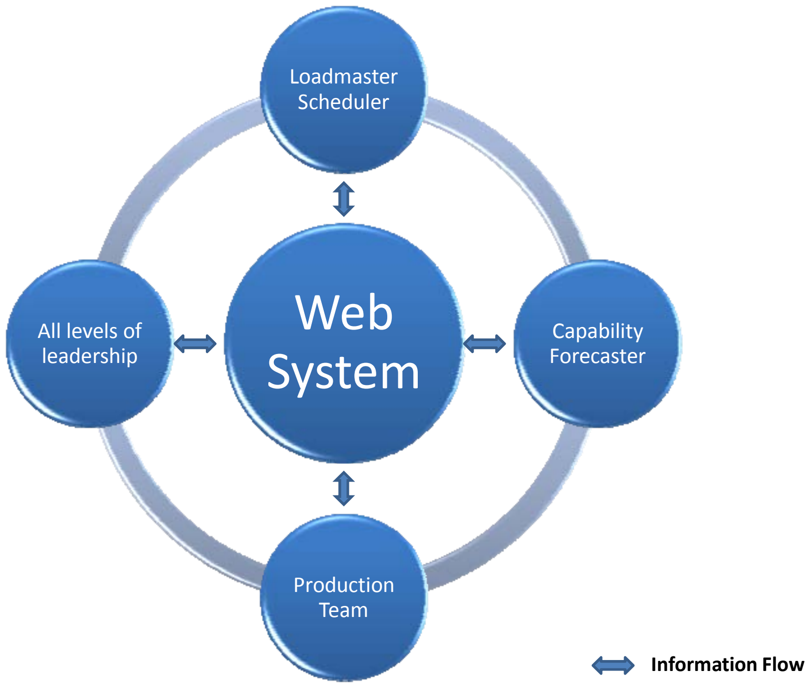


Figure 3: Improved Information Flow

Adding Predictability and Efficiency: although there is a large amount of unused capacity within the production process, encouraging our customers to just increase demand and reduce that inefficiency in that manner is ill advised and not a feasible option in the long term. However, a supply chain that is not robust to withstand severe spikes in demand is not feasible in the short term. Creating a web-based system capable of only accepting increases in demand along a specific timeline will ensure agility and allow the production team to move toward a constant work in progress (CONWIP) model and more effectively using labor hours. The proposed model would accept demand 72 hours in advance as opposed to 24 hours experienced with the former process. Customers would have access to the maximum production capacity, i.e. 15 heavy loads and 30 containerized loads, if the order is placed in the web-based system anytime before the 72 hour mark. Prioritization would remain as it is under the current process but be managed by each loadmaster scheduler encouraging interaction between customers and commands throughout the base. The potential demand threshold would continue to decrease as aircraft takeoff time approached (figure 4). By helping to reduce uncertainty, this artificially imposed forecast horizon will reduce both lead times and unmet demand. This would also help to eliminate the operational waste experienced in the former process by the elimination of the inflexible bottleneck related to the "10 and 24" capacity threshold.

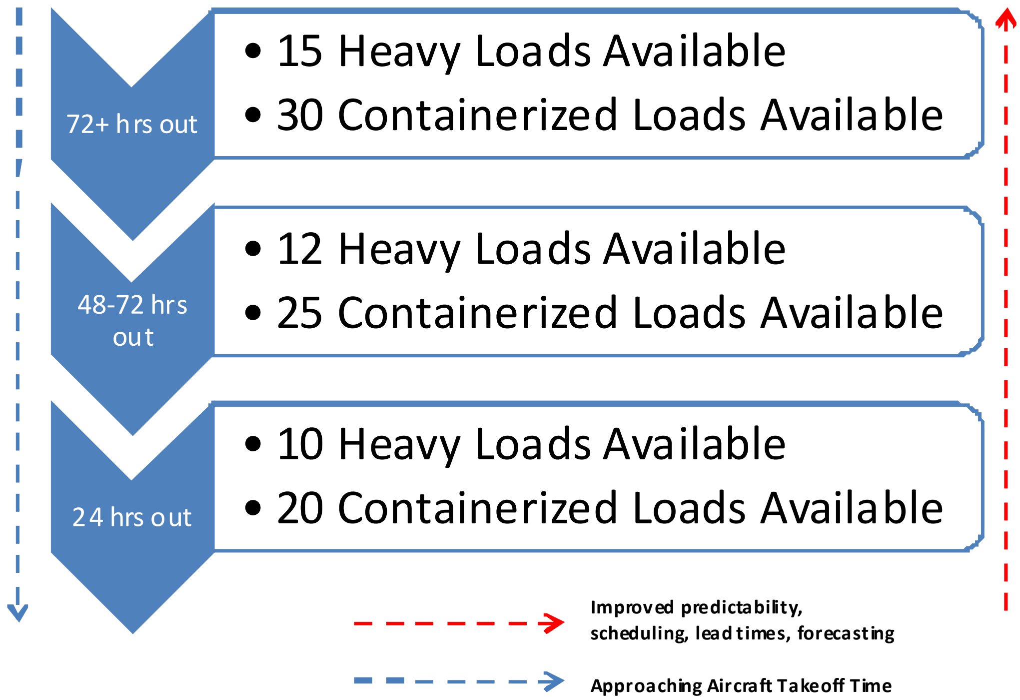


Figure 4: Improved Forecasting & Load Availability

Meeting Customer Demand: The new model would allow for surges in the supply chain by large margins: up to 125% for heavy loads and 40% for containerized loads, which is exactly what our customers are requesting. Product variety greatly increases the complexity of managing the process and therefore the proposed model would only schedule the three most commonly requested loads: heavy, containerized and tactical training bundle. Exceptions to these products would be handled by the production team leader and the customer as it has been under the current process.

Reuse of Operational Waste: The new proposed model also addresses the problems caused by load cancellation by creating an inventory holding area that has not previously existed. The negative effects that cancelled requests have the production team would be partially mitigated and downloaded loads would be transported to the inventory holding area for re-inspection and re-certification for up to a maximum of five heavy and six containerized platforms. Although this doesn't stop weather cancellations or reduce overbooking, the cancelled loads are no longer "wasted" by re-inserting them back into the production pipeline and consuming the same resources (line space and labor) twice. The amount of on-hand inventory in the holding area would be visible on the web-based system to the customer and accessible in real-time. The current prioritization constraints (priority 1, 2 & 3) observed in the former process would be implemented in the holding area. Although conditionally dependant this new inventory holding area would allow the supply chain to flex beyond maximum capacity on a limited basis.

Conclusion

The development of this model would be a joint effort between the 19th Communications Squadron and the 19th Logistics Readiness Squadron but once created it would have the potential to not only eliminate all problems experienced with the former system but allow for a more robust and flexible supply chain. By integrating the front end, customer demand, to the back end, the production and manufacturing portion within the Logistics Readiness Squadron, we incorporate the needed elements of both a pull and push system to create a hybrid structure capable of supporting the many different needs of the multiple organizations on base.

Summary of Improvements

- Centralize demand information
- Reduce uncertainty
- Move labor toward a constant work in progress (CONWIP); similar to the kanban practice
- Reduce variability of the customer demand process (leveling demand)
    - Provide each stage of the chain w/ complete real-time information
- Improve/Reduce lead-time
    - Fill demand for orders that cannot be filled from the line
    - More accurate forecast due to a decreased forecast horizon
- Create Strategic partnerships
    - Customer-managed inventory; encourage conflict resolution and improve communication between commands, potentially addressing the issue of overbooking
- Establish effective and standardized forecasts
    - Judgment methods left to the experts (loadmaster schedulers)
- Reduce impact of causal methods on the system

- weather, maintenance, training requirements and other uncontrollable variables

- Reuse Operational Waste
- Improve Supply Chain flexibility by over 30% from the former process

Historically, the supply chain and logistics process supporting aerial delivery at Little Rock Air Force Base were put in place over three decades ago and have remained relatively unchanged since. This would not present such a problem but for two realities encountered during the same window of time: we're engaged in a conflict that places a higher premium on air drop capability and our customers relying on logistics process supporting this capability have fundamentally changed over the decades. The creation of a 21st century logistics process with increased agility and improved information accuracy is long overdue.

References

ATTACHMENT A- Labor Data

	TASK	Time	Minutes
3	**Initial wooden CDS Build Up**		**Minutes**
4	Cut/drill 8x8 timbers	3	180
5	Bolt together assembly	1	60
6	Wrap in canvas bag	1	60
7	Sling load w/A-22	1	60
8	Prep skidboard	0.3	18
9	Cut energy dis. pad	0.3	18
10	Attach skidboard	0.2	12
11	Attach 26' parachute	0.2	12
12	Weigh and tag load	0.2	12
13		**7.2**	432
14			
15	**CDS reconstitution**		
16	Inspection	0.3	18
17	Re-prep load	0.5	30
18	Prep skidboard	0.3	18
19	Cut energy dis. pad	0.3	18
20	Attach skidboard	0.2	12
21	Attach 26' parachute	0.2	12
22	Weigh and tag load	0.2	12
23		**2**	120
24			
25	**Initial Heavy Equipment assm**		
26	Build Type IV platform	5	300
27	Attach EFTC/bracket/latch	1.5	90
28	Cut/assemble ballast load	4	240
29	Lashings/binders	1.5	90
30	slings/clevis'	1	60
31	deadman rigging	1	60
32	M-1 function check	0.5	30
33	M-1 attachment	0.25	15
34	Stow slings/deadman/M-1	0.5	30

Hrs Per Person

Blue =	Pre-Production
Yellow =	Production
Green =	Post Production or Recovery

Total Hours Spent per Stage

Stage	Hours
Blue =	23.95
Yellow =	8.7
Green =	1.53

Realized Hours Spent per Stage

Stage	Hours	% of Total
Blue =	1.0021	8%
Yellow =	8.7	66%
Green =	3.53	27%
Total =	**13.23**	

- Realized numbers are a product of how often each stage is completed daily throughout the course of 1 year. This also

-13.24hrs produces (3 units) 1HE, 1CDS, 1TTB

Requested Demand(10/24) in Labor Hours
~includes TTB's~

Daily	149.96
Per Person	5.77

Unaccounted Hours

Per Person	1.73
Per Team	45.04

Residual Units per

Total =	10.21

- This number assumes all unaccounted for hours can be put back into labor tasks

2010 Assigned manning

35 total
~minus 5 for deployments~
30
~ minus 2, NCOIC/ Asst NCOIC~
28
~Minus 6 for DZ spt~
22
~Minus 2 sick/leave/appt~
20 for floor work

ATTACHMENT A - Labor Data (cont.)

35	Attach G-12 parachutes/risers	0.5	30
36	Attach rigged extraction pkg	0.5	30
37	Weigh and tag	0.25	15
38		**16.5**	990
39			
40	**Heavy Equipment reconstitution**		
41	M-1 function check	0.5	30
42	M-1 attachment	0.25	15
43	Stow slings/deadman/M-1	0.5	30
44	Attach G-12 parachutes/risers	0.5	30
45	Attach rigged extraction pkg	0.5	30
46	Weigh and tag	0.25	15
47		**2.5**	150
48			
49	**26' High Velocity parachute**		
50	layout	0.1	6
51	inspection	0.15	9
52	air	0.15	9
53	fold	0.25	15
54	pack	0.1	6
55		**0.75**	45
56			
57	**15' Extraction parachute (all types)**		
58	layout	0.1	6
59	inspection	0.15	9
60	air	0.15	9
61	fold	0.25	15
62	pack	0.1	6
63		**0.75**	45
64			
65	**60' Line bag**		
66	Inspection	0.05	3
67	rig/tag	0.15	9
68		**0.2**	12
69			

ATTACHMENT A - Labor Data (cont.)

70	**J model 60' Line bag**		
71	Inspection	0.1	6
72	Rig/tag	0.7	42
73		**0.8**	48
74			
75	**9 foot deployment line**		
76	Inspection/Rig	**0.05**	3
77			
78	**Initial TTB**		
79	Fill sand bag	0.05	3
80	Sew bag closed	0.05	3
81	Layout 68" pilot chute	0.05	3
82	Inspection	0.05	3
83	Re-pack	0.05	3
84		**0.25**	15
85			
86	**TTB reconstitution**		
87	Layout 68" pilot chute	0.05	3
88	Inspection	0.05	3
89	Re-pack	0.05	3
90		**0.15**	9
91			
92	**G-12 packing**		
93	Layout	0.45	27
94	Inspection	0.3	18
95	Air/prep lines/apex	0.3	18
96	Pack/stow	0.45	27
97		**1.5**	90
98	All DZ recovery times est based on distance from		
99	**Heavy Recovery**		
100	Recover HE extractipn pkg	0.25	15
101	Prep HE	0.05	3
102	Fork HE to safe zone	0.15	9
103	Recover G-12s	0.5	30
104	Load HE/prep trailer/tiedown	0.1	6

ATTACHMENT A – Labor Data (cont.)

105		**1.05**	63
106			
107	**CDS Recovery**		
108	Recover 26' parachute	0.15	9
109	Fork to safe zone	0.15	9
110	Load CDS/Tiedown	0.1	6
111		**0.4**	24
112			0
113	**Recover TTB**	**0.08**	4.8

ATTACHMENT B – 2009 Load Data

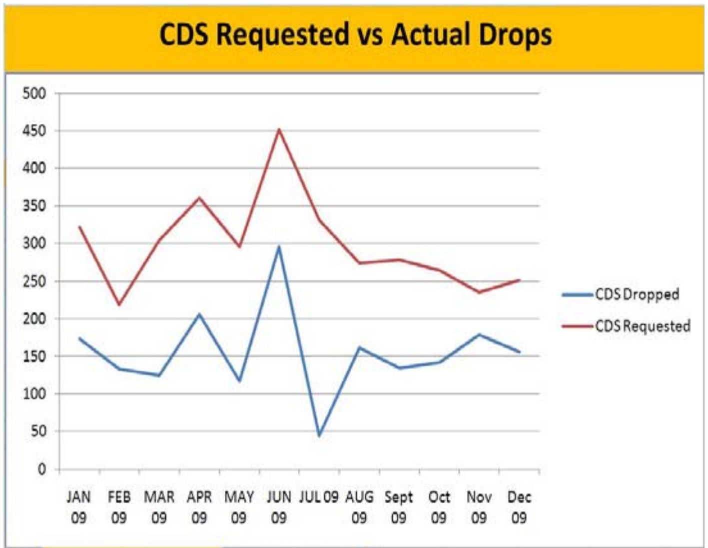
	CARGO/TONS	A/C WORKED	HE/REQ	HE/L	HE/DL	HE/USED
JAN 09	69	907	176	118	40	78
FEB 09	107	1029	172	125	23	102
MAR 09	101	996	162	100	16	84
APR 09	154	1203	204	163	16	147
MAY 09	150	1027	158	119	26	93
JUN 09	113	1062	209	183	23	160
JUL 09	72	1053	196	152	12	140
AUG 09	112	1013	185	130	11	119
Sept 09	59	945	168	139	28	111
Oct 09	127	907	148	113	33	80
Nov 09	43	886	142	122	14	108
Dec 09	42	891	166	134	19	115
TOTALS	1149	11919	2086	1598	261	1337

	CDS/REQ	CDS/L	CDS/DL	CDS/USED
JAN 09	321	216	43	173
FEB 09	219	180	47	133
MAR 09	304	176	51	125
APR 09	360	293	87	206
MAY 09	295	201	84	117
JUN 09	451	391	96	295
JUL 09	331	256	212	44
AUG 09	274	206	45	161
Sept 09	278	220	86	134
Oct 09	264	195	53	142
Nov 09	235	192	13	179
Dec 09	251	195	39	156
TOTALS	3583	2721	856	1865

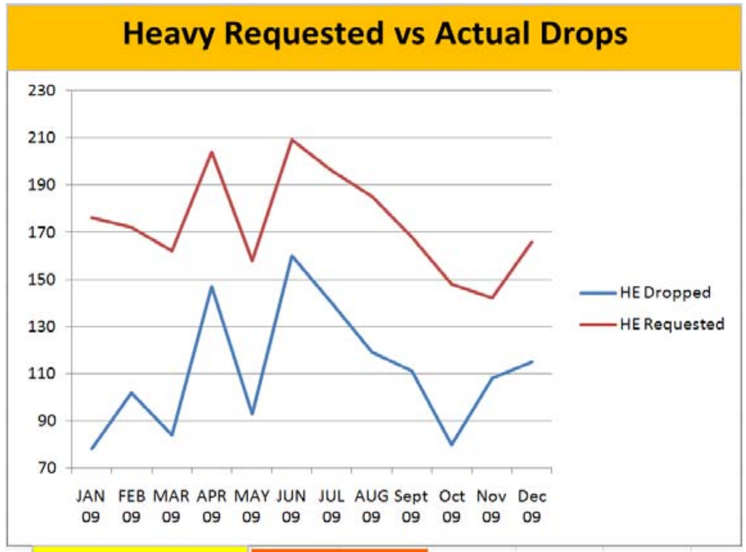
	TTB/REQ	TTB/L	TTB/DL	TTB/USED	TL/REC	TL/L&DL	TL TONS
JAN 09	794	641	459	182	152	123	390
FEB 09	967	773	534	239	144	129	318
MAR 09	917	713	423	290	158	138	436
APR 09	1019	889	546	343	159	149	396
MAY 09	806	584	419	165	134	119	378
JUN 09	1115	883	601	282	83	77	274
JUL 09	1147	865	562	303	52	92	137
AUG 09	1101	880	507	373	57	96	111
Sept 09	1001	829	634	195	176	150	212
Oct 09	882	782	523	259	49	41	184
Nov 09	835	798	501	297	48	45	188
Dec 09	976	900	572	328	45	37	119
TOTALS	11560	9537	6281	3256	1257	1196	3143

	Monthly Reques	Monthly Used(HE,CDS,TTB)
JAN 09	1291	433
FEB 09	1358	474
MAR 09	1383	499
APR 09	1583	696
MAY 09	1259	375
JUN 09	1775	737
JUL 09	1674	487
AUG 09	1560	653
Sept 09	1447	440
Oct 09	1294	481
Nov 09	1212	584
Dec 09	1393	599
TOTALS	17229	6458

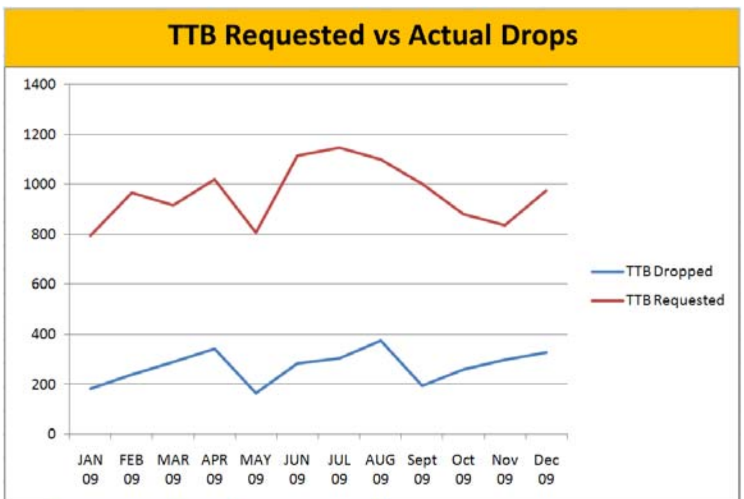
ATTACHMENT C – Graphical Representation of Load Data



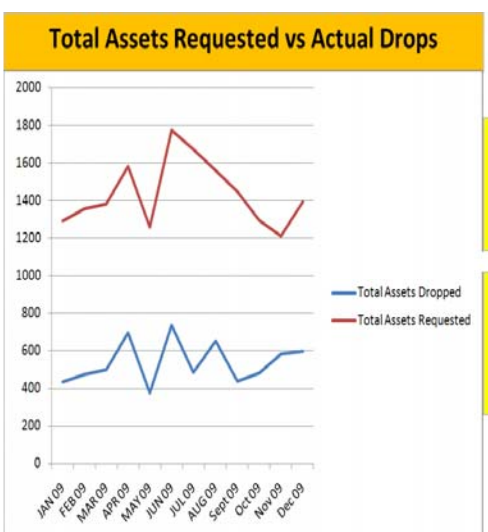
CDS Load Unused Requests	48%



Heavy Load Unused Requests	36%



TTB Load Unused Requests	72%



Total Assets Unused Requests	63%
Heavy & CDS Unused Requests	42%

ATTACHMENT D – Seasonal Data

09 Precip	Monthly Used(HE,CDS,TTB)	Monthly Ld'd	Monthly Req
2.57	251	334	497
2.36	235	305	391
6.51	209	276	466
5.6	353	456	564
12.93	210	320	453
2.77	455	574	660
9.12	184	408	527
1.94	280	336	459
6.84	245	359	446
15.81	222	308	412
1.11	287	314	377
12.05	271	329	417
79.61	**3202**	**4319**	**5669**
	Used	**Loaded**	**Requested**
Monthly Seasonal Ave.	**266.83**	**359.92**	**472.42**

Average Precipitation(past 34 years) in inches	
JAN	3.7
FEB	3.7
MAR	5.2
APR	5.5
MAY	5.3
JUN	3.9
JUL	3.3
AUG	3.5
Sept	4.3
Oct	3.6
Nov	5.5
Dec	4.7
Total	52.2

Seasonal Indices(used)		Seasonal Indices(loaded)		Seasonal Indicies(Requested)	
0.940662086		0.927992591		1.052037396	
0.880699563		0.847418384		0.827659199	
0.783260462		0.766844177		0.986417358	
1.322923173		1.266959944		1.193861351	
0.78700812		0.889094698		0.958899277	
1.70518426		1.594813614		1.397071794	
0.689569019		1.13359574		1.11554066	
1.04934416		0.933549433		0.971599929	
0.91817614		0.997453114		0.944081849	
0.831980012		0.855753647		0.872111484	
1.075577764		0.872424172		0.798024343	
1.01561524		0.914100486		0.882695361	

	= **more** than average
	= **less** than average

ATTACHMENT E – Regression Analysis

StatTools (Core Analysis Pack)

Analysis: Regression

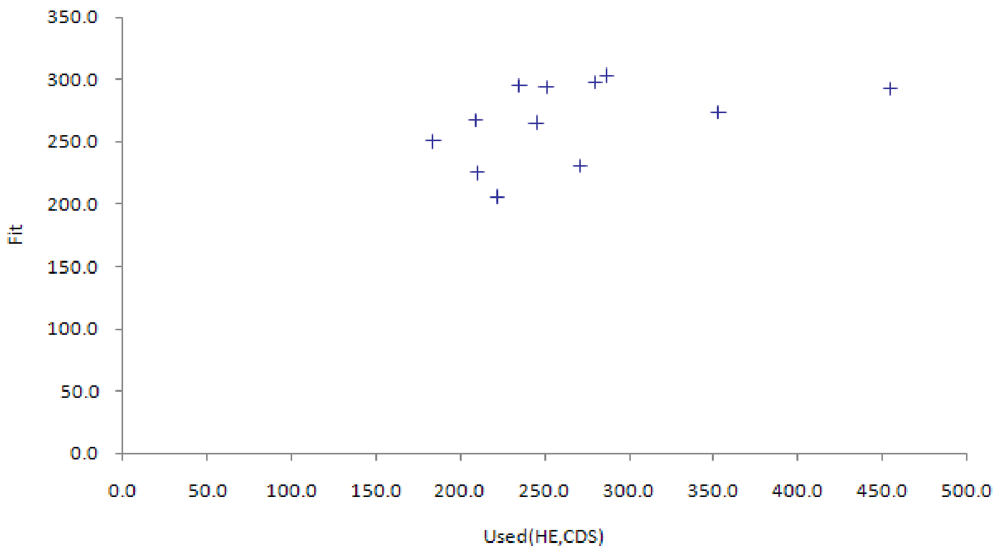
Performed By: Kaz

Summary	Multiple R	R-Square	Adjusted R-Square	StErr of Estimate
	0.4357	0.1899	0.1088	70.07671376

ANOVA Table	Degrees of Freedom	Sum of Squares	Mean of Squares	F-Ratio	p-Value
Explained	1	11508.20855	11508.20855	2.3435	0.1568
Unexplained	10	49107.45812	4910.745812		

Regression Table	Coefficient	Standard Error	t-Value	p-Value	Confidence Interval 95% Lower	Confidence Interval 95% Upper
Constant	310.739606	35.09753139	8.8536	< 0.0001	232.5374327	388.9417793
09 Precip	-6.618204647	4.323247092	-1.5308	0.1568	-16.25099946	3.014590165

Scatterplot of Fit vs Used(HE,CDS)



Graph Data	Used(HE,CDS)	Fit	Residual	APE	MAPE
1	251	293.7308201	-42.7308201	17%	18%
2	235	295.120643	-60.120643	26%	
3	209	267.6550937	-58.6550937	28%	
4	353	273.67766	79.32234003	22%	
5	210	225.1662199	-15.1662199	7%	
6	455	292.4071791	162.5928209	36%	
7	184	250.3815796	-66.3815796	36%	
8	280	297.900289	-17.900289	6%	
9	245	265.4710862	-20.4710862	8%	
10	222	206.1057905	15.89420948	7%	
11	287	303.3933988	-16.3933988	6%	
12	271	230.99024	40.00976	15%	