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UPDATED ARMY COOK STAFFING MODEL TO REFLECT WORKLOADS GENERATED BY CURRENT FIELD FEEDING OPERATIONS, GROUP RATIONS, AND KITCHENS

by
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Approved for public release; distribution is unlimited

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14. ABSTRACT
To improve the effectiveness of field feeding operations, the U.S. Army in recent years fielded the new Container Kitchen, new Modern Burner Unit, and two new group rations - the Unitized Group Ration - A (UGR-A) and Unitized Group Ration - Heat/Serve (UGR-H/S). These fieldings were designed to increase the frequency and quality of group hot meals and reduce the cook workloads generated by field feeding operations. This report details the development of an updated cook staffing model for Army units to cover the actual workloads generated by current field kitchen equipment, and group rations. To develop the cook staffing model, work sampling data was collected for 17 different unit kitchens covering 45 complete meal periods to include a variety of different type/size units and mixes of on-site to remote site feeding. In developing the updated model, any required workload assumptions always estimated actual cook workloads on the high side to insure the proposed updated staffing levels were more than adequate to cover actual maximum average cook workloads. The updated staffing model indicates required cook staffing levels for larger unit kitchens are significantly less than those presently authorized. For example, a MARC Code 21A unit kitchen feeding 775 Soldiers is presently authorized 20 cooks but the updated model indicates only 12 cooks are actually required.

15. SUBJECT TERMS

HEATING	HOT MEALS	FIELD RATIONS	MOBILE KITCHENS	MBU(MODERN BURNER UNIT)
SAMPLING	MODELING	FIELD KITCHENS	MILITARY RATIONS	UNITIZED GROUP RATION
STAFFING	FOOD SERVICE	GROUP RATIONS	PORTABLE EQUIPMENT	
WORKLOAD	FIELD FEEDING	DATA COLLECTION	CONTAINER KITCHENS	

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Preface

This report details a food service personnel or cook staffing model for Army units and field kitchens. The staffing model is based on the detailed analysis of kitchen work sampling data collected during field training exercises for a variety of Army units and field feeding situations. The work sampling data reflects kitchen workloads generated by current Army field feeding operations, field kitchens, and group rations. Field kitchen work sampling data collection covered 7 training exercises to include 17 field kitchens, 45 complete meal periods, and the preparation of a total of 24,250 group meals. Data collection covered field training exercises at several installations to include: Fort Bragg, Fort Hood, Fort Stewart, Pohakuloa Training Area, National Training Center, and Joint Readiness Training Center. This work was conducted during the period October 2004 - September 2005 under the U.S. Army Natick Soldier Center Combat Feeding Research and Engineering Program project D610.

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Executive Summary

This report details an updated cook staffing model for Army unit field kitchens. The model was developed based on work sampling data covering 17 different unit field kitchens and 45 complete meal periods. The collected work sampling data covered a wide variety of units, field kitchens, and feeding situations to include: small, medium, and large field kitchens supporting from under 100 Soldiers to 1,700 Soldiers; on-site and remote site feeding mixes from 100% on-site to 100% remote site, both Mobile Kitchen Trailer (MKT) and Container Kitchen (CK) field kitchens, and both Army group rations to include the Unitized Group Ration -A (UGR-A) and Unitized Group Ration - Heat/Serve (UGR-H/S).

A prior Technical Report, Natick TR-05/004 "Army Field Kitchen Workloads and Fuel Consumption," provided a detailed discussion and analysis of the collected work sampling data and results and a comparison with historical work sampling data for Army field kitchens with the prior more labor intensive group "A" and "B" rations and M-2 burners. This report indicated the new UGR-A and UGR-H/S and Modern Burner Unit (MBU) significantly reduced overall kitchen cook workloads as compared to field kitchens with "A" and "B" rations and M-2 burners. For a field kitchen supporting 900 Soldiers, this estimated workload reduction equated to about 7 cook positions.

This report details the development of an updated unit kitchen cook staffing model for current Army field feeding operations, kitchens/burners, and group rations. The model was developed based on the 45 meal periods of collected work sampling data. In developing the updated model, potential actual cook workloads were always estimated on the high side to insure proposed staffing levels were more than adequate to cover cook workloads for any feeding situation. For example, cook workloads are highest for 100% on-site feeding mix, lower for mixes of on-site and remote site feeding, and lowest for 100% remote feeding. Therefore the updated cook staffing model was developed based on the highest potential workloads associated with 100% on-site feeding. Also, all work hours associated with cook only work tasks (e.g. food preparation), or tasks that might be performed by cooks or KPs (e.g. on-site supply or serving), were assumed to be cook only work hours even through KPs typically perform most of the on-site supply workload to unload/store received supplies, and some of the serving activities. As a result the updated cook staffing model was developed based on estimated required cook work hours even higher than the maximum required cook work hours associated with 100% on-site feeding.

The resulting updated cook staffing model includes a fixed component of 2 positions to cover the supervisor position and off-site resupply cook hours to pickup and return required supplies to the kitchen, plus a variable workload component dependent on the total number of Soldiers supported only. The updated staffing model results in similar staffing levels at the lower feeding levels. Compared to current unit kitchen cook authorizations, the updated staffing model results in similar cook authorizations at the lower feeding levels but diverging and lower staffing levels for larger field kitchens. For

MARC Code 21A/31A units, the current and updated staffing model both result in 6 authorized cook positions for field kitchens supporting 175 total Soldiers. However, for larger kitchens supporting 525 and 875 Soldiers each, the current staffing criteria generate cook authorizations of 14 and 21, respectively, while the updated cook staffing model generates significantly reduced cook authorizations of only 10 and 13 positions.

In summary, based on the 45 complete meals of work sampling data and actual cook workloads, current cook authorization criteria appear to significantly overestimate actual required cook positions for larger consolidate battalion level kitchens. For the larger unit kitchens, based on the collected data, the maximum potential cook workloads are significantly lower than those required to support current authorizations.

UPDATED ARMY COOK STAFFING MODEL TO REFLECT WORKLOADS GENERATED BY CURRENT FIELD FEEDING OPERATIONS, GROUP RATIONS, AND KITCHENS

Introduction

Background

During the late 1970's and early 1980's, the Natick Soldier Center conducted several field feeding technology demonstrations and field experiments to evaluate the effectiveness and work loads generated by then current and alternative field kitchens and ration concepts to support Army field feeding operations. Over the past several years, the Army has updated overall field feeding operations with a totally new field kitchen, an improved burner system, and two new group ration concepts. Also, for the new Brigade Combat Team (BCT) force structure unit Class I configured loads will be delivered directly to each field kitchen rather than requiring cooks to travel to and pick them up at a Class I supply point. The focus of each of these was to simplify and improve field feeding operations, reduce cook workloads, and increase the capability and flexibility to provide Soldiers with a variety of frequent highly acceptable group hot meals.

The Army Field Feeding System (AFFS) supports a wide variety of different type and size units and feeding situations. An Army Mechanized Infantry Division with 17,844 total soldiers has 55 unit level field kitchens. These kitchens support a variety of different type units to include highly mobile combat units to less mobile combat support and combat service support units. The number of Soldiers supported by a kitchen range from under 100 for Artillery Battery kitchens to over 900 for the Main Support Battalion field kitchen. In addition, the mix of on-site/remote site meals can vary considerably between kitchens from mostly/entirely on-site for some units to mostly remote site for other unit kitchens. For some kitchens, the mix of on-site/remote site meals will also vary depending on the tactical situation or other factors. As an example, for the Mechanized Infantry Battalion kitchen, most/all meals could be on-site if the battalion was in a reserve status, or most could be provided as remote site meals if the unit was actively engaged in combat operations.

Overall project goals included:

- Collect the necessary data to identify the key kitchen workload drivers, and to quantify the direct field kitchen cook and KP workloads and associated staffing requirements generated by current Army field feeding operations, kitchens, and group rations.

- Utilize the results/findings to develop an updated Army cook and KP staffing model that addresses the workloads associated with the wide variety of potential Army field kitchen feeding situations and environments.

- Compare the current and resulting updated cook staffing model cook authorization levels as a function of type/size field kitchen and for the new Stryker Brigade Combat Team.

Objectives

The objectives of this report are to:

- Describe the methodology used to collect data to quantify unit kitchen cook and kitchen police (KP) workloads generated by current Army field feeding operations.
- Detail and discuss the kitchen and meal level workload data.
- Detail and discuss the developed cook and KP workload staffing model.
- Compare updated staffing model versus current staffing cook authorizations for the Stryker Brigade Combat Team (SBCT).

Field Kitchen Descriptions

The current Army Field Feeding System (AFFS) includes two different primary field kitchens - the Mobile Kitchen Trailer (MKT) and Container Kitchen (CK). For some units, these kitchens are authorized and operated at company level (e.g. Artillery Battery), and for other units at a higher or battalion level for other units (e.g. Mechanized Infantry Battalion). For those units where the MKTs and CKs are operated at battalion level, the Kitchen Company Level Field Feeding - Enhanced (KCLFF-E) is also authorized so to provide/maintain a limited company level food preparation capability.

The MKT depicted in Figure 1 was fielded in the 1975 time frame and designed to prepare bulk group "A" and "B" rations and to support company level feeding operations and up to 350 Soldiers. The MKT is mounted on a 1 ½ T trailer. With company level feeding operations, an Infantry Battalion with 5 companies and 827 total Soldiers was initially authorized 5 MKTs and each kitchen was operated as a separate company level kitchen. With the change to consolidated battalion feeding in the 1980's, MKT authorizations were based on the battalion's overall feeding strength and the Infantry Battalions MKT authorization was reduced to 3. With consolidated feeding, these 3 MKTS are all located at the battalion headquarter company and effectively function as one kitchen. Most Army units are still authorized and utilize the MKT as their primary field kitchen.

The newer CK shown in Figure 2 was designed for the Army's newer Unitized Group Ration - A (UGR-A) and Unitized Group Ration - Heat/Serve (UGR-H/S) and to support battalion level feeding operations and up to 800 Soldiers. The CK is housed in a

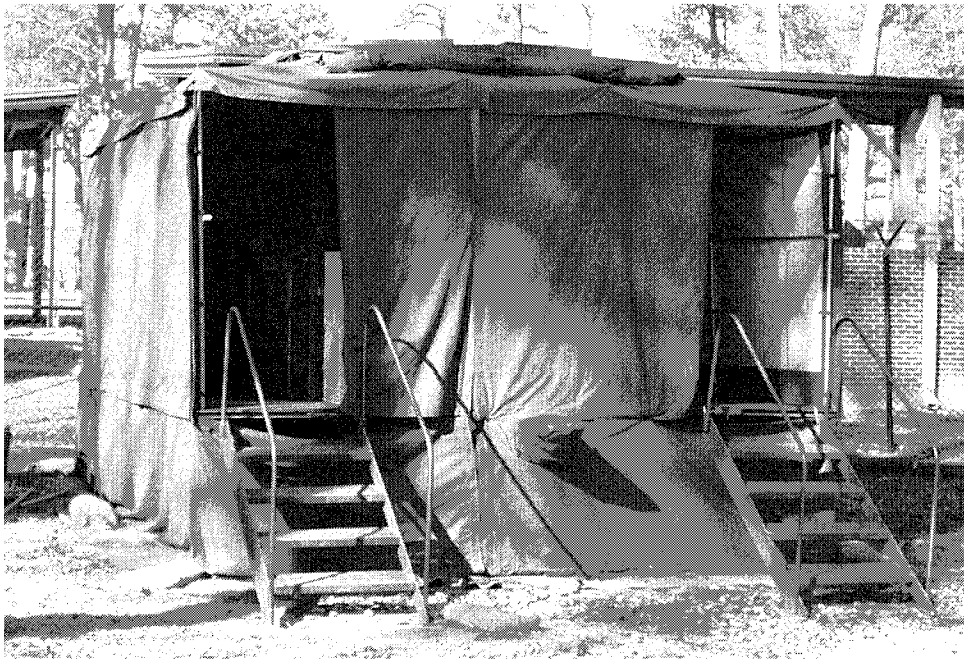

Figure 1. Mobile Kitchen Trailer - External View

Figure 2. Container Kitchen - Serving Line

trailer-mounted 3:1 expandable ISO container (8' x 8' x 20'). Fielding of the CK was initiated in 2001. The current total fielding requirement for CK's is 807 of which 288 are presently fielded. The CK is replacing the MKT on a 1 to 2 basis.

Group Ration Descriptions

The Army presently utilizes 2 different group rations to include the UGR-H/S and the UGR-A. For each menu, all items and quantities for 50 complete meals are packed or unitized into a set of 3 boxes. The UGR-H/S ration requires no refrigeration and consists of 3 semi-perishable boxes, while the UGR-A includes both a semi-perishable component (2 boxes) and a frozen component (1 box). The UGR-H/S is normally the first group ration utilized during operational deployments since it requires no refrigeration. Compared to the prior bulk "A" and "B" rations, a significant part of each of these rations consist of pre-cooked pre-portioned items so to reduce kitchen workloads and simplify field kitchen operations. For the UGR-H/S ration, the entrée, starch, and dessert meal components are typically provided as tray pack items. These items are thermally processed, pre-prepared, and shelf stable and packaged in sealed half-size steam table pans that only require heating and/or opening prior to serving. For the UGR-A ration, the entrée is typically provided as a frozen pre-cooked and portioned boil in the bag item (e.g. scrambled eggs, chicken breasts, BBQ pork, etc) that only require heating prior to serving, while desserts are provided as shelf stable products and only require opening.

Methodology

Approach

Field kitchen workloads are potentially dependent on or impacted by several factors to include: type field kitchen, type group ration, specific menu, total number of meals prepared, mix of on-site and remote site meals; and cook team focus on quality, training, motivation, experience, and productivity.

The general approach for data collection was to observe and collect workload data for a variety of different units and feeding situations during realistic field training exercises (FTXs). To the extent possible, exercises and specific unit kitchens were selected to collect kitchen workload data for both CKs and MKTs, for both group rations, for different feeding levels, and for different on-site versus remote site feeding mixes. Assigned cook team factors (e.g. experience, productivity, etc) were not considered in selecting specific kitchens for workload data collection.

Table 1. Field Kitchen Data Collection Summary

Kitchen Summary	Totals	Per Kitchen or Meal Period
Field Kitchens	17	-----
Meal Periods	45	1 to 4
Remote Sites	125	0 to 10
Meal Summary	**Totals**	**Per Meal Period (Min - Ave - Max)**
Onsite Meals	15,171	000 - 337 - 1700
Remote Meals	9,079	000 - 202 - 815
Total Meals	24,250	100 - 579 - 1700

Table 1 summarizes the overall work sampling data collection effort. To the extent possible, unit field kitchens were selected so to collect work sampling data for both MKT and CK kitchens, for both type UGR rations, and for a range of different total feeding levels and mixes of on-site to remote site meals. Data collection covered 17 unit field kitchens during 7 different FTXs. The 17 kitchens included 6 CK, 9 MKT, and 2 small KCLFF-E operations. Work sampling data collection for each kitchen ranged from 1 to 4 complete meal periods per kitchen and covered 45 total meal periods of which 41 had UGR-A rations and only 4 had UGR-H/S rations. Data collection for the UGR-H/S was restricted as available industrial base production was being reserved for the on-going Iraqi deployment. The meals per meal period ranged from 100 for a small KCLFF-E

kitchen to 1,700 for a large consolidated kitchen consisting of 2 CKs. The 45 meal periods of data collection covered the preparation of 24,250 total meals of which 15,171 (62%) were for on-site and 9,979 (38%) were for remote feeding. The mix of on-site and remote meals varied from 100% on-site meals to over 90% remote site feeding. Relative to small kitchens, one observed kitchen prepared 100 meals all for on-site feeding while another kitchen prepared 150 meals all for remote site feeding. For large kitchens, one kitchen prepared 850 meals all for on-site feeding, and another kitchen prepared 850 total meals of which 760 were for remote site feeding. The number of remote sites per meal period ranged from 0 for some kitchens to 10 for other kitchens.

Field Kitchen Data Collection

To evaluate kitchen workloads and staffing requirements, descriptive kitchen and work sampling data was collected for each kitchen and meal period. Descriptive kitchen data included:

- Quantity and type field kitchen plus extra equipment,
- Type group ration and specific menu,
- Total meals prepared,
- Number remote feeding sites and number meals per site, and
- Available on-site meals (total meals minus remote site meals).

The work sampling method of data collection was utilized to quantify the direct kitchen workloads for each field kitchen by meal period. For the work sampling data collection, a set of kitchen work tasks that covered the major kitchen work activities and other on-site productive work activities were pre defined. The defined set of direct kitchen work tasks included:

- Food preparation,
- Serving,
- Supervision,
- Other Food Service,
- Other Non Food Service,
- Remote Feeding,
- Kitchen Sanitation,
- Pot/Pan Sanitation,
- Supply
- Burner Maintenance, and
- Generator/Other Maintenance.

To insure consistency across data collectors, the work activities covered by each task were defined. For example, the work activities covered by the tasks food preparation and serving were:

Food preparation - All work activities and efforts associated with the preparation and cooking of food items to include: breakout/assembly of menu items or ingredients to prepare, stirring/mixing ingredients, actual cooking, monitoring cooking process, beverage preparation, obtaining cooking water, salad preparation, transferring prepared/cooked foods to insulated containers or other containers for on-site or remote feeding.

Serving - Setting up and tearing down the hot and cold serving lines, manning the serving line whether actively serving or not, monitoring serving lines for status, replenishment of serving lines, arranging serving line items, etc.

The Other Food Service and Other Non Food Service tasks captured all productive work efforts expended by cooks and KPs in and around the kitchen area and not covered by the other specifically defined work tasks. Work efforts captured under Other Food Service tended to be cook work activities to include: cooks receiving supervision, cook meetings, and general planning. Work efforts captured under Other Non Food Service tended to be more KP work activities. Examples of Other Non Food Service work activities include: KPs receiving supervision, cleaning/maintaining hand washing units, digging drainage pit, tightening camouflage nets, etc.

To estimate the total kitchen workload for each meal period, work sampling data was collected at 15 minute intervals to include on the hour, quarter hour, and half hour. For each meal period, the work sampling data collection period covered all associated productive work efforts from the start of initial meal period work activities to the completion of final after meal period clean-up work activities. Between the breakfast and dinner meal periods, there is typically a 3-4 hour period during which there is limited to no work activity. During this period, cooks and KPs typically return to their tents to rest. For each kitchen, on some days data collection covered only 1 meal period per day and other time's it covered both the breakfast and dinner meals. When data collection covered 2 meal periods, a break point was selected during the 3-4 hour between meal quiet period, and work activities prior to this time allocated to the breakfast meal, and all work activities after this time allocated to the dinner meal.

At each observation point, all cooks and KPs in and around the kitchen and sanitation center was observed and evaluated as being productive (working) or non-productive (not working). For those rated as productive, each was then categorized as performing the work task that best fit their observed work activities. The clock time and the combined number of cooks and KPs performing each work task were recorded on the data sheet. The supervisory, cook, and KP work sampling data was rolled together and not maintained separately by type worker. For example, if the supervisor, 3 cooks and 1 KP were observed as Serving, then 5 was recorded on the data sheet under the task Serving. Also, no data was recorded to indicate the number of non-productive supervisors, cooks, and KPs at each observation point.

Kitchen workloads by meal period were estimated from the work sampling data as follows. For each meal period, the recorded observations for each work tasked were

summed. The task totals were multiplied by the observation interval of ¼ hour. This yielded the estimated meal period work hours for each task. The work hours by task are then summed across tasks to yield the total kitchen work hours for each meal period.

No effort was expended to locate and determine the status of any cooks and KPs not seen in or around the direct kitchen, sanitation center, and/or ration storage areas. As a result, any work activities expended by cooks or KPs in other areas are not reflected in the collected work sampling data. Examples of these other required productive work efforts include: time expended to pick up and deliver kitchen supplies (rations, ice water, fuel) from supply points, time to haul/dispose of kitchen rubbish; supervisor, cook and KP meetings in other areas (e.g. in living quarters tent); and off-site kitchen supervisor efforts to complete required paperwork, generate/place requisitions, etc. For the final kitchen staffing model, these off-site workloads need be estimated and added to those covered by the work sampling data to insure adequate and sufficient kitchen staffing levels.

Results and Discussion

Of the 17 kitchens for which work sampling data was collected, 3 of the CK kitchens operated in a large stationary permanent base camp environment similar to that planned for the units scheduled deployments to Iraq. The other 14 kitchens operated as mobile kitchens in a normal field environment. The KCLFF-E kitchens each utilized a single serving line for all hot, cold, and self serve meal components. All of the MKT and CK kitchens setup and utilized two separate serving lines. For these kitchens, the internal kitchen serving line was typically utilized for the hot meal components, and a second serving line was utilized for all other meal components such as hot/cold beverages, desserts, salads, breads, condiments, etc. For the three permanent base camp CK kitchens, the second serving line was setup inside the large dining shelters. For all other kitchens, this serving line was setup outside under the kitchens camouflage netting. For some kitchens, the second serving line was totally self-serve while for others it was staffed with 1-3 attendants to serve some items like salads or canned fruit/pudding, and to monitor and replenish the line as required.

As previously detailed, the work sampling data for supervisors, cooks, and KPs was all combined and not collected separately by type worker. To estimate the workloads by worker category required assumptions and allocating the workloads for each task back to the various worker categories.

The task supervision clearly covered work activities typically performed only by the kitchen supervisor or senior food service person. Therefore the work hours for this task allocated 100% to the supervisor worker category. This was the only work task associated with the supervisory worker category.

The associated workloads for the pot/pan sanitation and rubbish removal tasks were 100% allocated to the KP worker category. Each of these tasks covered work activities typically performed only by KPs.

All other tasks and associated workloads were 100% allocated to the cook worker category, even some of the work activities may be performed by KPs or the supervisor. As a result, estimated total cook work loads will be on the high side and the resulting proposed cook staffing levels more than adequate to cover any potential cook work efforts. Work efforts under the task food preparation are predominately done by cooks. However, sometimes the kitchen supervisor might perform some food preparation activities like cooking, or KPs might do some preparation of salad vegetables. The tasks serving, supply, or other non food service also cover work activities sometimes done by KPs. For serving, KPs are often utilized to staff, monitor, and/or replenish the outside non hot food serving line. For supply, KPs are typically used to unload received subsistence stocks and to place into storage. However, to insure more than adequate cook staffing, 100% of the work hours for these tasks were assumed to be cook work hours.

Table 2. Overall Field Kitchen Workload Summary

Worker Category	Work Activity	Total Work Hours	Ave. Hours/ Meal Period	% All Work
Supervisor	**Supervision**	**81.0**	**1.8**	**4%**
Cook	Food Prep	601	13.3	32%
	Remote Feeding	58	1.3	3%
	Serving	236	5.2	12%
	Misc Food Service	70	1.5	4%
	Misc Non Food Service	61	1.4	3%
	Kitchen Sanitation	112	2.5	6%
	Supply	106	2.4	6%
	Burner Maintenance	24	0.5	1%
	Other Maintenance	10	0.2	1%
	Total	**1277**	**28.4**	**68%**
KP	Pot/Pan Sanitation	468	10.4	25%
	Rubbish	67	1.5	3%
	Total	**535**	**11.9**	**28%**
All	**Total**	**1893**	**42.1**	**100%**

Table 2 summarizes the overall work sampling workload results for all 17 kitchens and 45 meal periods by worker category - supervisor, cook, and KP. The 45 meal periods of work sampling data collection covered an estimated total 1,893 total productive hours. Based on the assignment of work tasks to worker categories, the breakout of overall productive work hours was 4% supervisory, 68% cook, and 28% KP. Across all 45 meal periods, the average productive work hours per meal period were 1.8 supervisor, 28.4 cook, and 11.9 KP productive work hours or 42.1 total productive work hours. For cooks, the food preparation and serving tasks accounted for 47% and 18% or a significant 65% of the total productive cook work hours.

Variations in Work Hours per Meal Period

Based on the work sampling data, Table A-1 in the Appendix details the estimated productive work hours by kitchen, by meal period, and by task. While total kitchen workloads per meal period are impacted by certain workload drivers such as total meals prepared, the work sampling results also reveal that there can be considerable variation in

workloads per meal period for similar type kitchens and feeding situations, or even between meal periods for the same field kitchen. Figure 3 depicts these variations in total kitchen workloads to include supervisor, cook, and KP work hours per meal period as a function of total meals prepared. There are several potential explanations for the observed variations.

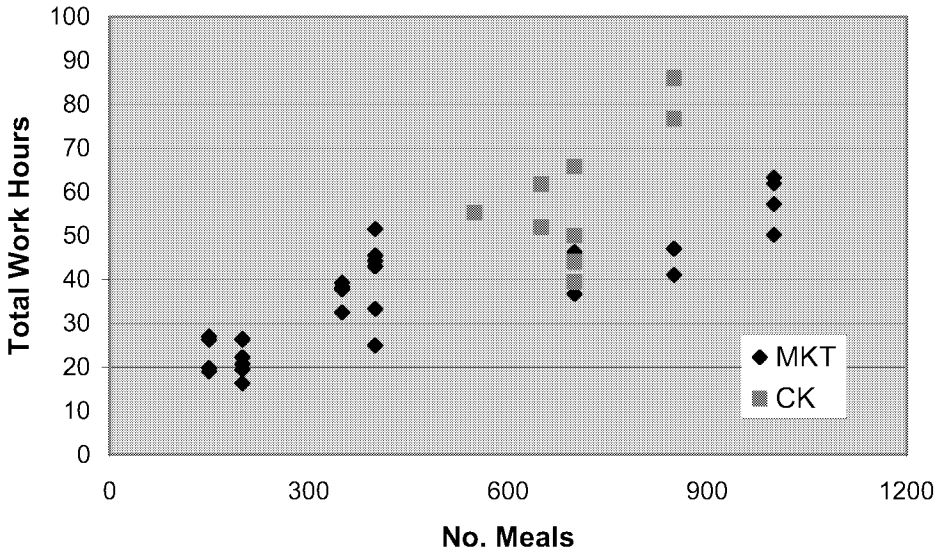

Figure 3. Total Kitchen Work Hours by Meal Period

Cook team experience, quality, and motivation. Each unit kitchen was operated by the unit's own set of cooks. Variations in the experience, quality, and motivation of each cook team can impact their effectiveness and efficiency and the resulting productive work hours expended for a particular feeding situation. No quantitative data was collected to assess these factors for each cook team. However, based on general observation, the cook teams for some kitchens were clearer more experienced, motivated, and productive than those for other kitchens. These differences may explain the resulting observed variations in productive work hours per meal between kitchens for similar feeding situations.

Actual menus prepared. The UGR-A includes 7 breakfast and 14 dinner menus. The required food preparation work effort can vary significantly depending on menu and type products and preparation required. A dinner menu with raw frozen steaks will require significantly more food preparation work hours than a dinner menu with a pre-cooked boil-in-the bag BBQ pork entrée that only requires in-the-bag-heating prior to serving. The frozen steak menu will likely also generate more kitchen sanitation and pot/pan sanitation work hours than the boil-in-bag BBQ Pork meal. For the work sampling data collection, there was no effort to control or fix which menus each kitchen

prepared. As a result, different kitchens prepared different menus and the overall data collection covered a wide variety of different menus to include high labor, mid labor, and low labor content menus. The potential effect of specific menus on kitchen work hours is reflected in the data for kitchens where work sampling data covered multiple meal periods. Data collection for Kitchen 1 and Kitchen 4 covered 4 meal periods each. For Kitchen 1, food preparation work hours per meal period varied between 10.5 work hours to 22.3 work hours or by over 100%. For Kitchen 5, the food preparation work hours varied from 12.5 to 22.5 or by 80%. By not fixing/controlling which menus each kitchen prepared, the resulting composite food preparation work hours across all kitchens and meal periods reflect the estimated average food preparation work hours across all menus. This is important as cook staffing levels need be calculated based on average kitchen workloads per day or year across the complete range of all menus.

Preparation methods. Workloads can also vary significantly between kitchens for the same feeding situation and menu due to differences in the food preparation methods selected by each cook team. With some menus, there can be more than one method to prepare specific items. During actual data collection, two different field kitchens were observed on one day preparing the same breakfast menu that included pre-cooked boil-in-bag Canadian bacon, breakfast biscuits, and other items. At one kitchen, the Canadian bacon was heated in the bag in boiling water and then put in a steam pan for serving while the breakfast biscuits were just stacked in a pan and placed in an oven for warming prior to serving. This team selected the minimal effort method to prepare the breakfast items. At the other kitchen, the cooks grilled/browned the individual Canadian bacon slices and individually buttered/grilled the breakfast biscuits prior to serving. These preparation methods required more work effort but yielded products with higher better appearance and acceptance. The differences in selected preparation methods may be due to level of supervision, cook team motivation, and other factors.

Periodic meal period work loads. The major work tasks food preparation, pot/pan sanitation, and serving (if have on-site meals) occur during every meal period. Other tasks like supply or other non food service cover work activities that can be significant but do not occur every meal period. The supply task covers work efforts to unload and store received subsistence stocks at the field kitchen. However, for field training exercises, kitchens typically receive subsistence stocks once every two or three days. As a result this work activity occurs regularly but only during one meal period every two to three days. For large kitchens, the work hours to unload and store a two to three day supply of food by hand can be significant. As a result total kitchen workloads by meal period can vary significantly depending on whether the meal period included a supply receipt or not, or some other periodic workload. These impacts are clearly reflected in the detailed Table A-1 workload data by meal period and work task. Kitchen 17 supported 1,700 Soldiers and data collection covered 2 meal periods. During one meal period a large trailer of food was received and unloaded and the resulting supply workload was 12.5 hours. The supply workload for the other meal period without a supply receipt was much lower at 3.3 work hours. Kitchen 6 and Kitchen 14 data collection covered 4 meal periods each. Supply workloads by meal period for these kitchens also varied significantly depending on whether a supply receipt occurred or not.

For Kitchen 6 the supply workload varied widely from 0.0 to 5.3 work hours per meal period, while for Kitchen 14 the supply workload varied from 1.0 to 8.0 work hours per meal period.

Supplements - type and variety. The type and variety of meal supplements offered can also greatly impact the resulting food preparation and serving hours. Kitchens 1 to 14 all operated as regular mobile field kitchen and provided the typical limited group ration supplements like fresh whole fruit (e.g. apples, oranges, pears) and pre-made bagged chopped salads. Kitchens 15 to 17 at Fort Polk operated as large fixed base stationary kitchens similar to that planned for the units planned rotation to Iraq. These three kitchens offered an extensive variety of from scratch hand made vegetable and fruit salads similar to that planned for their scheduled deployment. These salads required extensive work efforts to peel, slice, chop, and assemble the various vegetable and fruit salads, and additional servers to staff, monitor, replenish, and clean the large cold food and beverage serving line.

Kitchen Workload Drivers

Figure 4 depicts the average overall direct kitchen workload (supervisor, cooks, and KPs) per meal period for the MKT and CK feeding up to 1,000 Soldiers.

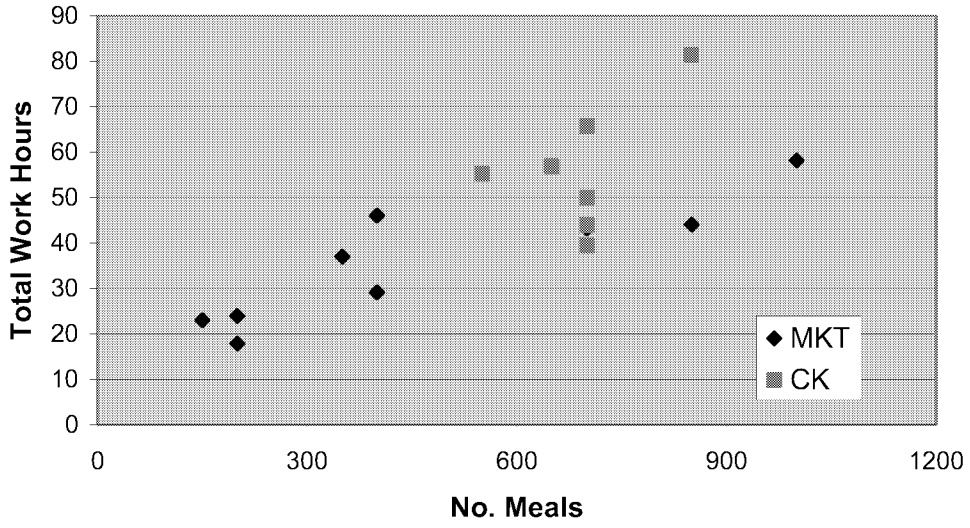

Figure 4. Average Total Work Hours per Meal Period by Kitchen

Before the start of data collection, the identified potential workload drivers included: type field kitchen, type group ration, specific menu, total meals prepared, and the mix of on-site to remote site meals. Each of these is qualitatively assessed below based on the work

sampling results/findings. In summary, the collected work sampling data indicated that kitchen workloads increase with the total meals prepared and number of on-site meals, and that a specific kitchens workload can vary significantly between meals depending on specific menu. However based on the available data, no significant differences or impacts on kitchen workloads due to the type field kitchen or type ration were identified.

Type Kitchen. The work sampling data collection covered 9 MKT field kitchens for 30 total meal periods, 6 CK field kitchens for 11 total meal periods, and 2 KCLFF-E kitchens for only 4 total meal periods. Units are authorized MKTs or CKs as their primary field kitchens, and in addition if needed additional KCLFF-Es so to maintain at least a limited company level group meal preparation capability.

Prior to the start of data collection, the CK was expected to be potentially more labor efficient and thus require fewer total work hours than the MKT for similar feeding situations. The CK is the newer kitchen and includes additional equipment like the tray ration heater, convection oven, warning oven, and in-kitchen refrigerator not provided with the older MKT. Also, the CK was designed for the current UGR-A and UGR-H/S group rations which utilize significant amounts or heat and serve pre-cooked and portion controlled menu items, while the MKT was designed for the prior group "A" and "B" rations that primarily included bulk frozen raw meats and other bulk items requiring extensive food preparation efforts prior to serving. Based on the collected work sampling data, there were no direct comparisons of CK and MKT kitchen workloads for similar feeding situations - - for example total meals prepared and mix of on-site/remote site meals. For the observed kitchens, the CK kitchens prepared an average 886 total meals per meal period versus 470 for the observed MKT operations. With the higher average meal counts, one would also expect the CK kitchens to be more efficient and utilize fewer work hours per 100 meals due to normal economies of scale. However, overall kitchen workloads per 100 prepared meals were similar for both kitchens and averaged 7.9 work hours for MKT kitchens and 7.7 for CK kitchens. Also, while the CK was expected to be more efficient relative to food preparation work hours, the average food preparation work hours per 100 meals were slightly higher for the CK at 2.6 work hours versus 2.4 work hours for the MKT. However, the slightly higher CK food preparation workloads per 100 meals may be attributable to the extra workload associated with the extensive variety of fresh cut vegetable and fruit salads provided by CK kitchens 15 to 17 as compared to the regular low labor pre-cut bagged salads and whole fruit (apples/pears) provided by the MKT kitchens. Based on the available work sampling data, there is no clear indication that type kitchen significantly impacts overall kitchen workloads.

Type Group Ration. The UGR-H/S ration was expected to possibly require fewer work hours than the UGR-A ration as it utilizes tray packs for the entrée which only require heating in hot water prior to serving. However, the UGR-A also utilizes pre-cooked frozen boil in the bag type entrees for many menus and higher labor content items (e.g. frozen raw steaks) only for other menus. Work sampling data collection relative to the UGR-H/S ration was very limited at only 4 meal periods to include one small KCLFF-E kitchen for 2 meal periods and 2 CK kitchens each supporting 700 Soldiers for 1 meal period each. Data collection for the 2 CK kitchens also covered 1 meal period

each for the UGR-A rations. For Kitchen 10, the food prep work hours for the UGR-H/S menu were 14.0 and for the UGR-A menu a higher 17.3. For Kitchen 12 the results were reversed and a higher 14.5 for the UGR-H/S menu and only 11.8 for the UGR-A menu. For both kitchens, the average food prep work hours were similar for each type ration at 14.3 work hours for the UGR-H/S and 14.5 for the UGR-A ration. Given the wide observed variations in workloads between meal periods even for the same kitchen due to menu impacts, the limited UGR-H/S data is insufficient to assess whether UGR-H/S food preparation workloads are less or the same as UGR-A workloads. However, even if less, the required kitchen staffing level would still be established based on the higher UGR-A workloads to insure adequate staffing to provide that ration whenever the supply system and tactical situation permitted.

Specific Menu. As previously detailed, the food preparation workload can vary significantly between meal periods for the same kitchen due to the specific menu prepared and associated labor content. For Kitchen 1, the food preparation workloads varied from 10.5 to 22.3 or by more than 100% over 4 meal periods. Similarly, for Kitchen 6, the food preparation workloads varied widely from 12.5 to 22.5 work hours or by 80% also over 4 meal periods. As previously mentioned, no effort was made to control or have each kitchen prepare the same menu. As a result the overall average food preparation workload across all kitchens reflects the average workload across all menus to include low labor, mid labor, and high labor menus.

Total Meals Prepared. Total kitchen workloads were expected to be dependent on and increase with the total number of prepared meals due to the extra work efforts to cook/prepare more meals, wash more pots/pans, unload/store more food stocks, and so on. This is clearly reflected in the scatter plot of overall average kitchen workloads per meal period in Figure 4 as a function of total meals prepared. As shown while there is variability between kitchens for various reasons, in general overall or total kitchen workloads tend to increase increased with increases in total meals prepared.

On-Site and Remote Site Meal Mix. Serving and overall kitchen work hours per meal period were expected to increase with the number of meals served on site. While all meals need be prepared, only those served on site generate serving workload. As a result, a unit that predominately supports on-site feeding will require more authorized cook hours than a same size unit supporting mostly off-site feeding. In addition, higher on-site meal mix will likely increase KP rubbish work hours since a larger portion of the disposable dinnerware rubbish is generated and left in the kitchen area. With remote site feeding, both of these functions are performed by others and not field kitchen personnel. The work sampling results clearly reveal that total kitchen serving work hours increase with the number of on-site meals. This is shown by Figure 5 that depicts the average serving work hours by kitchen per 100 meals as a function of total on-site meals. While there is considerable variation, the average serving work hours tend to fluctuate around a constant 1.5 work hours per 100 meals.

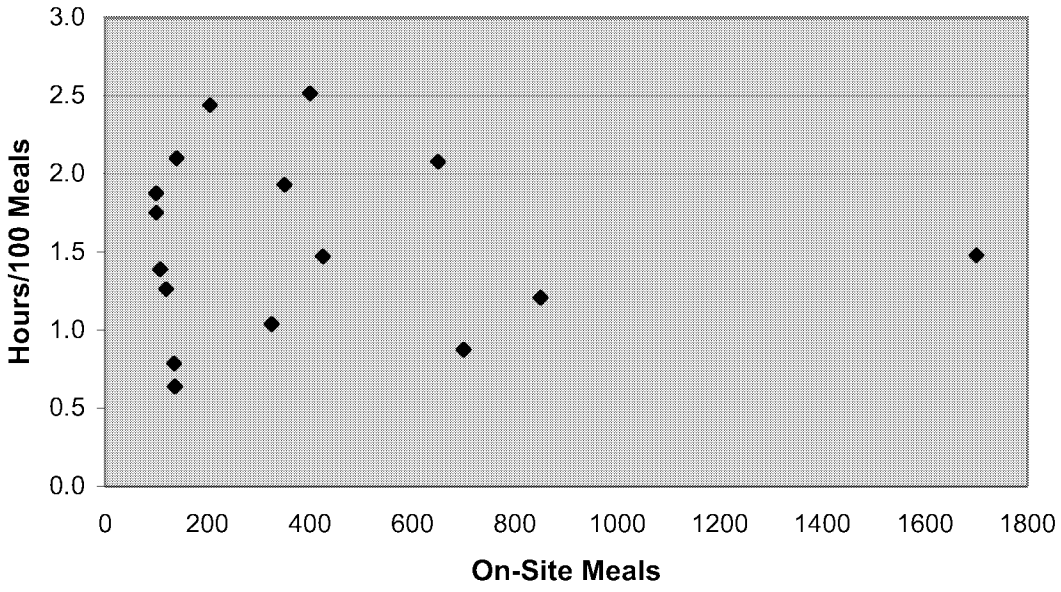

Figure 5. Serving Work Hours per 100 On-Site Meals

While the field kitchens for some units will feed most to all meals on-site all the time, kitchens for some combat units (e.g. Infantry or Tank Battalions) will sometimes primarily support on-site feeding and other times primarily remote site feeding depending on the tactical environment, unit missions, and other factors. Since either feeding environment can exist for an extended time period, the cook staffing levels for all units need be set based on the higher workloads associated with all on-site feeding. Therefore when the kitchen is supporting a high mix of remote site meals, it will be more than adequately staffed and the assigned cooks will be able to work shorter or reduced workdays.

Kitchen Cook Workload Models

Army field kitchen cook staffing levels are presently set based on the estimated annual kitchen work hours required to provide/support a specific feeding standard. The annual work hour requirement is converted to authorized cook positions based on a standard annual work hour per year availability factor per cook position. This factor varies by type units (e.g. combat, combat support, and combat service support) reflects the available work hours for MOS related duties given other expected non MOS work activities and work hours. The Army's field feeding standard is 2 group hot meals plus 1 MRE per Soldier per day whenever the tactical situation, supply system, and other factors permit. For many reasons, the actual ration mix Soldiers consume will vary over time from 3 MREs on some days 2 group meals and 1 MRE on other days, and even between units on the same day. While the tactical environment may permit 3 group hot meals per day, Army units are presently staffed with cooks for a 2 hot meal per day capability only. During the initial stages of deployments, units will typically consume only MREs for some time period. As the theater matures, the UGR-H/S is typically introduced as the first group ration and followed later by the UGR-A ration. Once the theater matures and stabilizes, unit kitchens will typically support and provide 2 group meals per day most of the time. As a result, unit kitchens need be staffed to cover the higher workloads associated with preparing and providing 2 group meals per day. The focus of the field kitchen work sampling data collection was to assess/update the annual field kitchen work hour requirements to support the Army's feeding standards of 2 group meals and 1 MRE per Soldier.

Cook Model Descriptions

Three general kitchen cook workload models were considered to analyze the kitchen cook workload data and to predict kitchen cook workloads as a function of key work load drivers - total meals prepared, on-site meals, and/or remote site meals. Each model is described below.

<u>One Component Model - Total Cook Work Hours.</u> As previously discussed, the workloads for 9 tasks were assumed to represent cook only work efforts. The 9 tasks included food preparation, remote feeding, serving, miscellaneous food service, miscellaneous non food services, kitchen sanitation, supply, burner maintenance, and other maintenance are assumed to represent cook only work efforts. For the one component workload model, the work hours for all 9 cook tasks were summed into one total cook work hour factor for each meal period. Regression analysis was then utilized to assess the best fit linear model and ability to accurately predict the resulting total cook work hours per meal period as a function of total meals, on-site meals, and/or remote site meals.

<u>Two Component Model - Serving and All Other Cook Work Hours Model.</u> For this model, total cook work hours per meal period were analyzed and modeled as 2

separate components to include serving hours and all other cook work hours. For this model, the all other cook work hour component was the sum of the work hours for the other 8 cook tasks. Rationale for this model was that serving hours was likely more related to on-site meals, while the all other work hour component was likely more dependent on total meals. For this model, stepwise regression analysis was utilized on each component separately to identify the best-fit model as a function of total meals, on-site meals, and/or remote site meals. With this model, the 2 separate component models were summed together to compare/evaluate predicted versus observed total cook workloads by meal period.

Three Component Model - Food Preparation, Serving, and All Other Cook Work Hours Model. With this model, the observed food preparation and remote feeding work hours were added together and modeled as one component, serving was modeled as the second component, and the work efforts for the other 6 cook tasks were summed and modeled as the third component. There were multiple reasons for considering a 3 component cook workload model. First, food preparation and serving alone reflect about 65% of overall cook workloads. These 2 work tasks also represent the major work activities that occur every meal period. In addition, food preparation hours are likely more dependent on total meals prepared while serving work hours are likely more related to on-site meals served. Therefore it was decided to model serving and food preparation as separate workload components. The all other cook work hours reflect workloads for the other 6 tasks that are highly variable from meal period to meal period, and type work activities that occur during some but not all work periods. As a result these work hours may or may not be dependent or impacted by total meals prepared, on-site meals, or remote site meals. Therefore the workloads for these 6 tasks were grouped and modeled as the third workload component. Stepwise regression analysis was conducted on each workload component to identify the best fit linear model for each as a function of total meals, on-site meals, and/or remote site meals. With this model, to assess and evaluate predicted versus observed total cook workloads, the 3 separate component models were added together.

Cook Workload Equations

The 3 candidate workload drivers or variables considered for each component model included:

ON = Onsite Meals,
OFF = Remote Site Meals, and
TOT = Total Prepared Meals.

In addition, onsite meals (ON) plus remote site meals (OFF) equals total prepared meals (TOT).

Based on stepwise linear regression analysis, the resulting best fit component workload models and associated overall cook workload models are presented and

discussed below. The total cook work hours equations for the one, two, and three component workload models each include the variables on-site meals and total meals, and none include remote site meals. The total cook hour workload equations for the 2 and 3 component workload models equal the sum of the equations for each component.

One Component Workload Model

Total Cook Hrs = 10.4500 + 0.0299*ON + 0.0166*TOT (Equation 1)

Two Component Workload Model

Serving Hrs	= 0.3655 + 0.0145*ON
Other Hrs	= 10.5700 + 0.0243*TOT .
Total Cook Hours	= 10.9355 + 0.0145*ON + 0.0243*TOT (Equation 2)

Three Component Workload Model

Serving Hrs	= 0.3655 + 0.0145*ON
Food Prep Hrs	= 3.8620 + 0.0205*TOT
Other Hours	= 6.4070 + 0.0093*ON .
Total Cook Hours	= 10.6345 + 0.0238*ON + 0.0205*TOT (Equation 3)

The one component workload model estimates the average cook workload per meal period at a fixed 10.45 work hours plus 2.99 work hours per 100 on-site meals plus 1.66 work hours per 100 total meals prepared.

For the two component model, the serving work hours per meal period are estimated at a small fixed 0.37 work hours plus 1.45 work hours per 100 on-site meals, while the remaining other cook hours are estimated at a fixed 10.57 work hours plus 2.43 work hours per 100 total prepared meals.

For the three component model, the equation for serving work hours is the same as for the two component model. Food preparation (plus remote feeding) work hours are estimated at a fixed 3.86 work hours plus 2.05 work hours per 100 total meals. The remaining other work hours are estimated at a fixed 6.40 work hours plus a low 0.93 work hours per 100 onsite meals. This indicates that the other cook hours are more random and not greatly impacted by on-site meals or total meals.

In comparing the resulting three total cook workload models, the fixed cook work hours per meal period for each model are very similar and range from 10.45 to only 10.94, or by only ½ hour. However, the aggregate workload factors for on-site meals and remote site meals very considerably between models. Relative to on-site meals, the workload factor per 100 meals varies from 1.45 to 2.99 work hours or by about 100%. Also the workload factor per 100 total meals varies 1.66 to 2.43 work hours or by about 50%. While the variations between models for each individual factor are large, an interesting assessment is the combined value of both factors for a model, and a

comparison of both factors between models. The one component workload model has the highest on-site meal workload factor at 2.99 and the lowest total meal factor at 1.66. The two component model is the opposite with the lowest on-site meal workload factor at 1.45 and highest total meal factor at 2.43. The workload factors for the three component model are in the middle at 2.36 for on-site meals and 2.05 for total meals. This indicates that while there can be large differences in one factor between models, that the explanation of overall kitchen workloads is simply shifting between factors for the different models.

Observed versus Predicted Average Total Cook Workloads by Kitchen

Based on the work sampling data, Table 3 summarizes the average work hours per meal period by kitchen, by work task, and by type worker - supervisor, cook, and KP. As previously discussed, all supervision work hours were allocated to the supervisory worker category, all pot/pan sanitation and rubbish removal work hours were allocated to the KP worker category, and all work hours for the other 9 tasks were assumed to be cook work hours. The more detailed by meal period data is provided in Table A-1 in the Appendix.

Table 4 details the predicted versus observed average total cook work hours per meal period for each model. The predicted cook work hours for each kitchen are based on the workload equations 1 to 3 and each kitchen's actual total meal and on-site meals. The observed cook work hours for the 2 KCLFF-E kitchens are a lot lower than those predicted by each of the 3 models. This was expected and is because the KCLFF-E provides only a limited group ration preparation capability as compared to the full group ration capability provided with MKTs or CKs. The observed work hours for the MKT and CK kitchens are sometimes higher and sometimes lower than those predicted by each model. Also while there is often a close match between the observed and predicted work hours, the differences are sometimes quite large. For the different MKT kitchens, the predicted average total cook work hours by kitchen ranged from 8.5 more to 8.4 less than the observed hours for the 2 component model, and from 7.8 more to 6.9 less for the 3 component workload model. However, much of this variation may be attributable to the limited meal periods per kitchen (1 to 4), kitchens preparing different menus with different labor content, and whether the covered meal periods included one or more non regular work activities, for example receive/store subsistence stocks, dig soakage pit, fix camouflage netting, etc.

Figure 6 depicts the difference between the predicted and observed average total cook work hours for the MKT and CK kitchens and the 2- and 3-component workload models. [Note: The 1 component model is not shown to reduce overall chart data points and clutter] As shown, the prediction workloads for both models are similar for each kitchen, and the predicted workloads appear to uniformly scattered and sometimes higher and sometimes lower than the observed workloads over the complete range of all size kitchens. This suggests that linear regression models are appropriate for modeling overall cook workloads.

Table 3. Average Kitchen Work Hours per Meal Period

Kitchen Data								Productive Work Hours by Task												Hours By Type Worker			
No.	Type	Type UGR Ration	Meal Periods	Remote Sites	On-site	Total Remote Meals	Total Meals	Food Prep	Serving	Supervision-S	Other Food Service	Other Non Food Serv	Remote Feeding	Kitchen Sanitation	Pot/Pan Sanit-KP	Rubbish Removal-KP	Supply	Burner Maint/Repair	Gen/Other Maint.	Supervisor Hrs	Cook Hrs	KP Hrs	All
9	KCL	H/S	2	0	100	0	100	2.4	1.8	0.1	0.6	0.3	0.0	0.0	0.9	0.3	0.1	0.0	0.0	0.1	5.1	1.1	6.4
8	KCL	A	2	0	100	0	100	3.5	1.9	0.0	0.5	0.5	0.0	0.8	1.3	0.3	0.4	0.5	0.0	0.0	8.0	1.5	9.5
5	MKT	A	4	4	0	150	150	6.1	0.0	1.9	2.5	1.3	1.8	1.1	5.2	0.3	1.8	0.5	0.6	1.9	15.7	5.4	23.0
4	MKT	A	4	1	140	60	200	6.3	2.9	1.9	2.4	1.2	1.3	1.5	3.3	0.3	1.8	0.5	0.6	1.9	18.6	3.5	23.9
7	MKT	A	2	3	108	92	200	6.1	1.5	1.1	0.6	0.6	0.8	2.0	3.8	0.5	0.6	0.3	0.0	1.1	12.5	4.3	17.9
13	MKT	A	4	0	350	0	350	10.1	6.8	4.4	1.3	2.3	0.0	1.8	7.6	0.7	1.2	0.7	0.3	4.4	24.2	8.3	36.9
14	MKT	A	4	0	400	0	400	13.8	10.1	0.6	0.4	1.3	0.0	3.9	8.8	1.8	4.5	0.9	0.0	0.6	34.9	10.6	46.1
2	MKT	A	2	2	325	75	400	7.0	3.4	1.0	1.8	1.1	0.8	2.3	9.0	0.8	1.5	0.5	0.1	1.0	18.4	9.8	29.1
1	MKT	A	4	7	119	581	700	16.4	1.5	0.6	0.6	0.9	3.4	1.6	14.5	1.2	1.4	0.8	0.3	0.6	26.9	15.7	43.3
3	MKT	A	2	8	137	713	850	15.4	0.9	0.1	0.9	1.0	2.9	1.9	17.6	1.1	2.1	0.1	0.0	0.1	25.1	18.8	44.0
6	MKT	A	4	10	185	815	1000	17.4	1.1	2.5	1.9	2.0	4.8	3.3	20.0	1.4	2.1	1.1	0.6	2.5	34.3	21.4	58.2
11	CK	A	1	4	205	345	550	15.5	5.0	5.0	6.5	0.0	2.3	2.3	15.0	0.8	2.3	0.8	0.0	5.0	34.5	15.8	55.3
15	CK	A	2	0	650	0	650	18.9	13.5	3.3	1.5	0.9	0.0	1.6	8.6	3.0	5.4	0.3	0.0	3.3	42.0	11.6	56.9
10	CK	Both	2	0	700	0	700	15.6	6.1	2.5	1.6	4.9	0.0	6.0	16.6	0.9	3.0	0.4	0.3	2.5	37.9	17.5	57.9
12	CK	Both	2	4	425	275	700	13.1	6.3	0.0	1.4	0.0	1.0	2.8	15.5	1.6	0.0	0.1	0.0	0.0	24.6	17.1	41.8
16	CK	A	2	0	850	0	850	30.6	10.3	4.8	1.9	3.0	0.0	5.3	14.9	5.4	5.0	0.4	0.0	4.8	56.4	20.3	81.4
17	CK	A	2	0	1700	0	1700	39.5	25.1	1.3	2.6	0.5	0.0	6.5	19.6	8.0	7.9	0.3	0.0	1.3	82.4	27.6	111.3

Table 4. Comparison of Observed and Predicted Average Total Cook Work Hours per Meal Period by Kitchen

Kitchen Data								Actual Cook Work Hours	Workload Model					
									1 Component		2 Component		3 Component	
No.	Type	Type Ration	No. Meal Periods	Remote Sites	On-site Meals	Remote Meals	Total Meals		Predicted	Difference (Pred-Actual)	Predicted	Difference (Pred-Actual)	Predicted	Difference (Pred-Actual)
9	KCL	UGR-H/S	2	0	100	0	100	5.1	15.1	10.0	14.8	9.7	14.7	9.6
8	KCL	UGR-A	2	0	100	0	100	8.0	15.1	7.1	14.8	6.8	14.7	6.7
5	MKT	UGR-A	4	4	0	150	150	15.7	12.9	-2.7	14.6	-1.1	13.3	-2.3
4	MKT	UGR-A	4	1	140	60	200	18.6	18.0	-0.6	17.8	-0.7	17.7	-0.9
7	MKT	UGR-A	2	3	108	92	200	12.5	17.0	4.5	17.4	4.9	16.9	4.4
13	MKT	UGR-A	4	0	350	0	350	24.2	26.7	2.5	24.5	0.3	25.8	1.6
14	MKT	UGR-A	4	0	400	0	400	34.9	29.1	-5.8	26.5	-8.4	28.0	-6.9
2	MKT	UGR-A	2	2	325	75	400	18.4	26.8	8.4	25.4	7.0	26.2	7.8
1	MKT	UGR-A	4	7	119	581	700	26.9	25.6	-1.3	29.7	2.7	27.5	0.5
3	MKT	UGR-A	2	8	137	713	850	25.1	28.7	3.5	33.6	8.5	31.0	5.8
6	MKT	UGR-A	4	10	185	815	1,000	34.3	32.6	-1.7	37.9	3.7	35.2	0.9
11	CK	UGR-A	1	4	205	345	550	34.5	25.7	-8.8	27.3	-7.2	26.4	-8.1
15	CK	UGR-A	2	0	650	0	650	42.0	40.7	-1.3	36.2	-5.8	39.1	-2.9
10	CK	Both	2	0	700	0	700	37.9	43.0	5.1	38.1	0.2	41.3	3.4
12	CK	Both	2	4	425	275	700	24.6	34.8	10.2	34.1	9.5	34.7	10.1
16	CK	UGR-A	2	0	850	0	850	56.4	50.0	-6.4	43.9	-12.5	47.9	-8.4
17	CK	UGR-A	2	0	1,700	0	1,700	82.4	89.5	7.1	76.9	-5.5	85.6	3.2

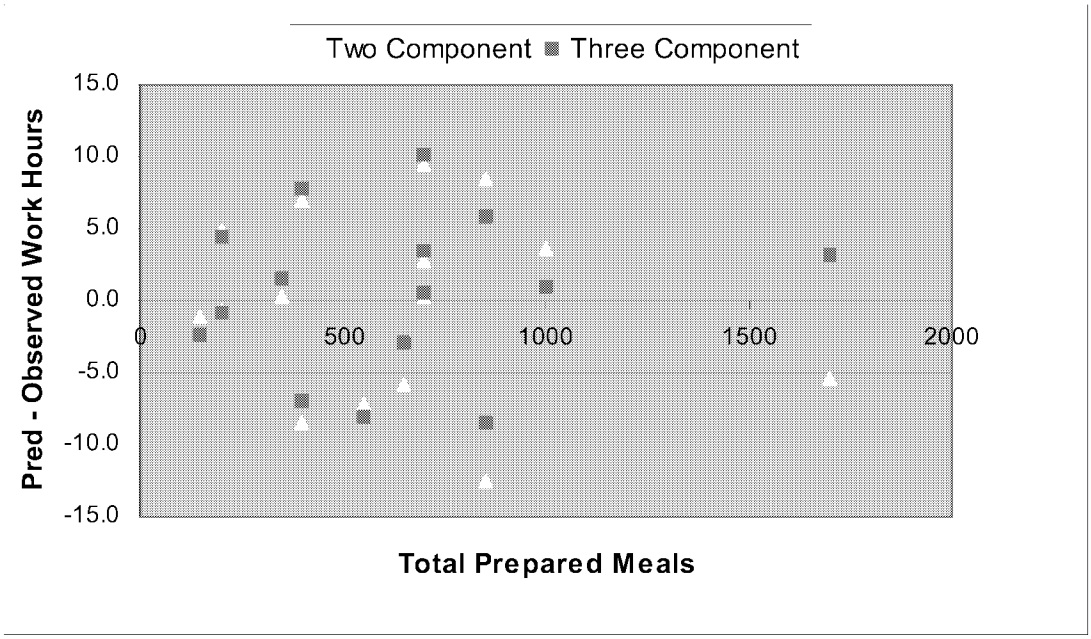

Figure 6. Predicted Less Observed Average Cook Work Hours by Kitchen

Observed versus Predicted Average Total Cook Workloads for Similar Size Kitchens

The cook work hours by meal period can differ a lot depending on whether a high or low labor menu was prepared and whether one or more high labor work tasks that occur only during some meal periods, for example unload and store a 2-3 day supply of food), occurred or not. Also if the data collection for each kitchen covered several more meal periods, the resulting average cook workloads per meal period for each would more accurately reflect each kitchens actual average cook workload across all menus and the observed average work hours for similar kitchens and feeding situations would tend to be closer together.

Table 5 groups the work sampling results by meal period for same and similar size kitchens in terms of total meals prepared. The 6 groupings include 100 meals, 150 to 200 meals, 350 to 400 meals, 550 to 700 meals, 850 to 1000 meals, and 1,700 total meals. The objective for analyzing the grouped data was to assess how well the 3 models estimate the average observed workloads for groups of similar size kitchens covering multiple kitchens, more total meal periods, and more different menus. The 100 total meal group included the data for the 2 KCLFF-E kitchens and 4 total meal periods. Each group from 150 to 200 meals up to the group for 850 to 1,000 meals included workload data for 3 to 5 different MKT and/or CK kitchens and a total 8 to 11 meal periods each. These feeding strengths, from 150 to 1,000, cover the range of normal kitchen feeding strengths associated with Army company and battalion level kitchen feeding operations.

Table 5. Comparison of Observed to Predicted Cook Work Hours for Similar Size Kitchens

Kitchen/Meal Data							Actual Total Cook Work Hours	Workload Model					
								1 Component		2 Component		3 Component	
No.	Kitchen	Type Ration	Meal/Menu	On-site Meals	Remote Meals	Total Meals		Predicted	Pred-Observed	Predicted	Pred-Actual	Predicted	Pred-Actual
9	KCL	UGR-H/S	D	100	0	100	5.5	15.1	9.6	14.8	9.3	14.7	9.2
9	KCL	UGR-H/S	D	100	0	100	4.8	15.1	10.4	14.8	10.1	14.7	10.0
8	KCL	UGR-A	D	100	0	100	8.0	15.1	7.1	14.8	6.8	14.7	6.7
8	KCL	UGR-A	D	100	0	100	8.0	15.1	7.1	14.8	6.8	14.7	6.7
		Average	**4**	**100**	**0**	**100**	**6.6**	**15.1**	**8.5**	**14.8**	**8.3**	**14.7**	**8.1**
5	MKT	UGR-A	B9	0	150	150	14.8	12.9	-1.8	14.6	-0.2	13.3	-1.4
5	MKT	UGR-A	B10	0	150	150	13.8	12.9	-0.8	14.6	0.8	13.3	-0.4
5	MKT	UGR-A	D10	0	150	150	16.0	12.9	-3.1	14.6	-1.4	13.3	-2.7
5	MKT	UGR-A	D12	0	150	150	18.3	12.9	-5.3	14.6	-3.7	13.3	-4.9
4	MKT	UGR-A	B2	140	60	200	18.5	18.0	-0.5	17.8	-0.7	17.7	-0.8
4	MKT	UGR-A	B4	140	60	200	17.3	18.0	0.7	17.8	0.6	17.7	0.5
4	MKT	UGR-A	D3	140	60	200	18.8	18.0	-0.8	17.8	-0.9	17.7	-1.0
4	MKT	UGR-A	D5	140	60	200	19.8	18.0	-1.8	17.8	-1.9	17.7	-2.0
7	MKT	UGR-A	B4	108	92	200	13.3	17.0	3.7	17.4	4.1	16.9	3.7
7	MKT	UGR-A	D5	108	92	200	11.8	17.0	5.2	17.4	5.6	16.9	5.2
		Average	**10**	**78**	**102**	**180**	**16.2**	**15.8**	**-0.4**	**16.4**	**0.2**	**15.8**	**-0.4**
13	MKT	UGR-A	D	350	0	350	24.3	26.7	2.5	24.5	0.3	25.8	1.5
13	MKT	UGR-A	B4	350	0	350	20.8	26.7	6.0	24.5	3.8	25.8	5.0
13	MKT	UGR-A	D9	350	0	350	27.5	26.7	-0.8	24.5	-3.0	25.8	-1.7
13	MKT	UGR-A	B5	350	0	350	24.3	26.7	2.5	24.5	0.3	25.8	1.5
14	MKT	UGR-A	D	400	0	400	34.8	29.1	-5.7	26.5	-8.3	28.0	-6.8
14	MKT	UGR-A	B4	400	0	400	30.5	29.1	-1.5	26.5	-4.0	28.0	-2.5
14	MKT	UGR-A	D9	400	0	400	40.5	29.1	-11.5	26.5	-14.0	28.0	-12.5
14	MKT	UGR-A	D5	400	0	400	33.8	29.1	-4.7	26.5	-7.3	28.0	-5.8
2	MKT	UGR-A	D6	325	75	400	21.8	26.8	5.1	25.4	3.6	26.2	4.5
2	MKT	UGR-A	D	325	75	400	15.0	26.8	11.8	25.4	10.4	26.2	11.2
		Average	**10**	**365**	**15**	**380**	**27.3**	**27.7**	**0.4**	**25.5**	**-1.8**	**26.8**	**-0.5**

Table 5 (cont'd). Comparison of Observed to Predicted Cook Work Hours for Similar Size Kitchens

Kitchen/Meal Data							Actual Total Cook Work Hours	Workload Model					
								1 Component		2 Component		3 Component	
No.	Kitchen	Type Ration	Meal/Menu	On-site Meals	Remote Meals	Total Meals		Predicted	Pred-Observed	Predicted	Pred-Actual	Predicted	Pred-Actual
11	CK	UGR-A	D14	205	345	550	34.5	25.7	-8.8	27.3	-7.2	26.4	-8.1
15	CK	UGR-A	D6	650	0	650	45.3	40.7	-4.6	36.2	-9.1	39.1	-6.2
15	CK	UGR-A	D	650	0	650	38.8	40.7	1.9	36.2	-2.6	39.1	0.3
10	CK	UGR-H/S	D2	700	0	700	30.0	43.0	13.0	38.1	8.1	41.3	11.3
10	CK	UGR-A	B4	700	0	700	45.8	43.0	-2.8	38.1	-7.7	41.3	-4.5
12	CK	UGR-H/S	D	425	275	700	22.8	34.8	12.0	34.1	11.4	34.7	12.0
12	CK	UGR-A	B	425	275	700	26.5	34.8	8.3	34.1	7.6	34.7	8.2
1	MKT	UGR-A	B	83	617	700	28.8	24.6	-4.2	29.1	0.4	26.6	-2.2
1	MKT	UGR-A	B7	128	572	700	26.8	25.9	-0.9	29.8	3.1	27.7	0.9
1	MKT	UGR-A	D3	153	547	700	27.3	26.6	-0.6	30.2	2.9	28.3	1.0
1	MKT	UGR-A	D6	113	587	700	25.0	25.4	0.4	29.6	4.6	27.3	2.3
		Average	**11**	**385**	**293**	**677**	**31.9**	**33.2**	**1.3**	**33.0**	**1.0**	**33.3**	**1.4**
3	MKT	UGR-A	D	185	665	850	28.8	30.1	1.3	34.3	5.5	32.1	3.4
3	MKT	UGR-A	D10	90	760	850	21.5	27.3	5.8	32.9	11.4	29.8	8.3
16	CK	UGR-A	D8	850	0	850	52.3	50.0	-2.3	43.9	-8.3	47.9	-4.3
16	CK	UGR-A	D7	850	0	850	60.5	50.0	-10.5	43.9	-16.6	47.9	-12.6
6	MKT	UGR-A	D2	235	765	1000	39.0	34.1	-4.9	38.6	-0.4	36.4	-2.6
6	MKT	UGR-A	D4	235	765	1000	37.5	34.1	-3.4	38.6	1.1	36.4	-1.1
6	MKT	UGR-A	D5	147	853	1000	33.5	31.4	-2.1	37.4	3.9	34.3	0.8
6	MKT	UGR-A	D6	122	878	1000	27.0	30.7	3.7	37.0	10.0	33.7	6.7
		Average	**8**	**339**	**586**	**925**	**37.5**	**35.9**	**-1.6**	**38.3**	**0.8**	**37.3**	**-0.2**
17	CK	UGR-A	D9	1700	0	1700	86.5	89.5	3.0	76.9	-9.6	85.6	-0.9
17	CK	UGR-A	D	1700	0	1700	78.3	89.5	11.3	76.9	-1.4	85.6	7.3
		Average	**2**	**1700**	**0**	**1700**	**82.4**	**89.5**	**7.1**	**76.9**	**-5.5**	**85.6**	**3.2**

As expected, within each group, with each model the predicted cook work hours for any individual meal period is sometimes close, and sometimes much higher or lower than the actual hours based on the work sampling data. For the 550 to 700 total meal group, with the 2 component model, by meal period predicted cook hours ranged from 11.4 more to 9.1 less than actual cook hours, and for the 3 component model predicted hours ranged from 12.0 more to 8.1 less. For each grouping, the average on-site meals, remote site meals, total meals, and total cook work hours was calculated based on the same data for each meal period included in the group. For example, for the 550 to 700 total meal group, the average meal counts over the 11 meal periods was 385 on-site meals, 293 remote site meals, and 677 total meals; and the average actual cook work hours was 31.9 hours per meal period. The average meal counts for each group were then utilized with each model predict the average actual cook workload across all meal periods in the group. The predicted and actual cook work hours were then compared to determine how well each model predicted the actual observed work load for each group.

All 3 workload models significantly overestimated the average cook work hours for the 2 small KCLFF kitchens. Depending on model, the estimated 100 meal KCLFF-E hours ranged from 14.7 to 15.1 work hours while the actual average work hours were only 6.6 per meal period. This was expected as the KCLFF-E kitchens are utilized to provide only a limited group ration capability, and not the full or complete group ration capability provided by MKTs and CKs. The 1,700 meal group included data for a single CK kitchen and only 2 meal periods (not really a group). Depending on model, the estimated cook hours for these 2 meal periods ranged from 7.1 more to 5.5 less than the actual average cook work hours. However these high feeding levels are outside the normal range at which Army unit level feeding operations are organized, and only occur for large contractor operated dining facilities similar to those in Iraq, or for stationary Forward Operating Bases where multiple units each with their own organic field feeding capability consolidate their feeding operations.

All 3 models closely estimated the observed average total cook work hours for the meal groupings of 150-200 meals to 850-1,000 meals which covers the range at which Army feeding operations are organized. Of the 12 estimates for these groups (3 models x 4 groups), the estimated average cook hours were within 1.0 hour 7 out of 12 times, and always within 1.8 hours of the groups observed average cook hours. Figure 7 plots the difference between the predicted and observed average cook work hours by group and model. While all 3 models are quite accurate, the 3 component model is slightly better as its range of differences was only 1.9 work hours, versus 2.8 and 2.9 work hours for the other 2 models. In addition, underestimates of any group's average kitchen workloads per meal period was a minimal and a maximum of only 0.5 work hours for the 3 component model verses a higher 1.6 to 1.8 work hours with the other 2 models. Therefore the 3-component workload model appears to be slightly better predictor of average kitchen workloads for establishing required field kitchen staffing levels.

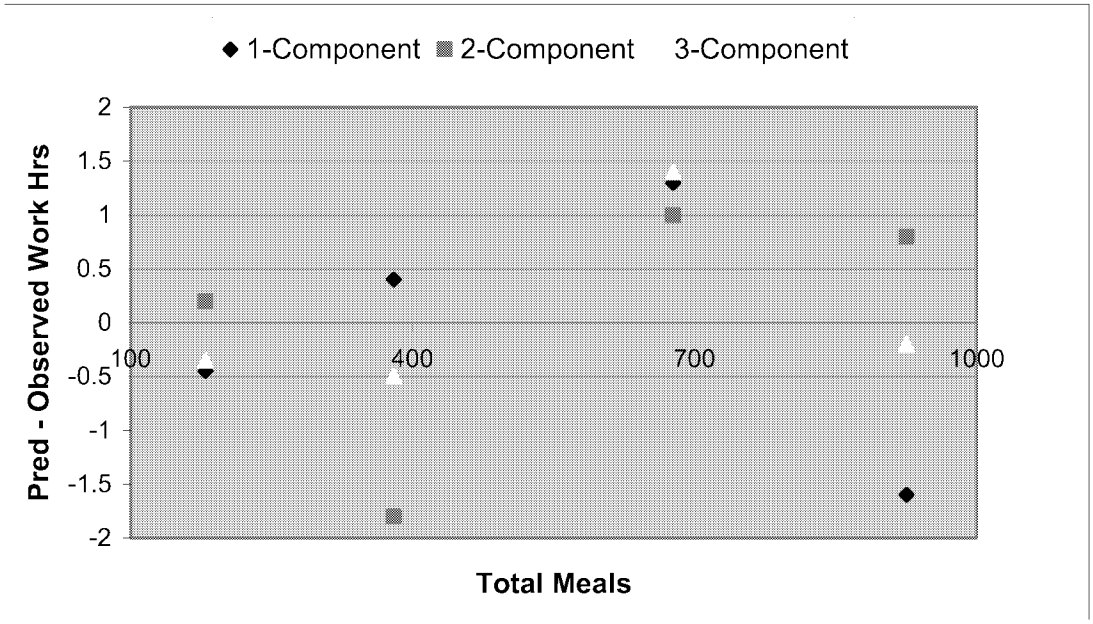

Figure 7. Predicted Less Observed Average Cook Hours by Kitchen Group

Kitchen Cook Workloads with 100% On-Site Feeding

Overall kitchen cook workloads are highest when all meals are fed on-site due to the extra cook work hours to serve all meals on-site as compared to when some to all meals are served at remote sites. This is reflected in each of the 3 "best-fit" composite total cook workload models as each includes on-site meals as a workload driver. Some Army units typically serve most to all group meals on-site all the time while other units, like combat maneuver battalions, will sometimes feed most to all meals onsite and other times most to all meals remotely depending on the tactical situation and missions. However, since these kitchens will sometimes predominately feed all meals on-site feeding for extended time periods, the cook staffing levels for all kitchens need be based on the higher workloads associated with 100% on-site feeding. With 100% on-site feeding, on-site meals (ON) and total meals (TOT) are the same and the 3 kitchen workload equations [Equation 1, Equation 2. and Equation 3] are simplified or reduced to:

<u>One Component Workload Model</u>

Total Cook Hrs = 10.4500 + 0.0465*TOT [Equation 4]

<u>Two Component Workload Model</u>

Total Cook Hours = 10.9355 + 0.0388*TOT [Equation 5]

Three Component Workload Model

Total Cook Hours = 10.6345 + 0.0443*TOT [Equation 6]

With these simplified models for estimating overall kitchen cook workloads for 100% on-site feeding, the fixed work hour component per meal period is the same as before [Equations 1-3]. However, the variable workload factor for each model is now total meals only with a tighter range of 3.88 to 4.65 work hours per 100 meals depending on model.

Table 6 details the estimated average total cook hours per meal period with each workload model for all on-site meals and all remote meals and different total feeding levels. The differences in workloads for all on-site and all remote site meals increase with the total meals prepared due to the variable workload factor associated with serving on-site meals. With the 3 component workload model, at 100 total meals estimated total cook work hours for all on-site meals are 15.1 or 19% higher than the 12.7 for all remote site meals; while at 900 total meals estimated total cook work hours for all on-site meals are 74% higher at 50.5 hours versus only 29.1 for all remote meals. The ratio of estimated total cook workloads for all on-site to all remote site meals at each feeding level is largest for the one component workload model, smallest for the two component workload model, and in between for the 3 component workload model.

Since kitchen cook staffing levels need be based on the higher workloads associated with all on-site feeding, the remote site to on-site work hour ratio indicates the percent of available cook work hours actually required or utilized when supporting and providing 100% remote site meals. Table 7 details the resulting all remote site to all on-site cook work hour rations for the 3 workload models and 3 feeding levels (300. 600, and 900 meals). As shown the predicted required cook work hours for all remote site feeding are always significantly less than for all on-site feeding. Depending on model and feeding level, required cook hours for all remote feeding range from only 48.5% to 80.3% of those required for all on-site feeding. As with the other comparisons, the results for the 3 factor model were in between those for the 1 and 2 factor models.

In comparing the estimated total cook work hours by model for all on-site and all remote site feeding, the 3 component model workload estimates are in between the estimates from the other two models. For the higher workloads associated with all on-site feeding, the cook workload estimates generated by the 3 component workload model are only slightly less (within 2-3 percent) of the highest estimates generated by the one component workload model.

Based on the closeness of the predicted to actual average cook workloads for grouped similar size kitchens (Table 5), and the predicted higher kitchen workloads for 100% on-site feeding, the 3 component cook workload model was selected as the best model for predicting on-site cook workloads for establishing updated required cook staffing levels.

Table 6. Predicted Total Cook Work Hours per Meal Period by Model and Feeding Level

Total Meals	All Remote Meals			All On-Site Meals			On-Site to Remote Ratio		
	Model Components			Model Components			Model Components		
	One	Two	Three	One	Two	Three	One	Two	Three
100	12.1	13.4	12.7	15.1	14.8	15.1	125%	111%	119%
300	15.4	18.2	16.8	24.4	22.6	23.9	158%	124%	143%
500	18.8	23.1	20.9	33.7	30.3	32.8	180%	131%	157%
700	22.1	27.9	25.0	43.0	38.1	41.6	195%	136%	167%
900	25.4	32.8	29.1	52.3	45.9	50.5	206%	140%	174%

Table 7. Predicted Cook Workloads by Model for All Onsite and All Remote Site Feeding

Total Meals	Model Components	Cook Work Hours/Meal Period		Remote Hours/ On-site Hours
		100% Onsite Meals	100% Remote Meals	
300	1	24.40	15.43	63.2%
	2	22.58	18.23	80.7%
	3	23.92	16.78	70.2%
600	1	38.35	20.41	53.2%
	2	34.22	25.52	74.6%
	3	37.21	22.93	61.6%
900	1	52.30	25.39	48.5%
	2	45.86	32.81	71.5%
	3	50.50	29.08	57.6%

Current Authorized Cook Staffing Criteria

The number of cook positions and type/quantity of field feeding equipment authorized a unit are detailed in the units Table of Organization and Equipment (TOE) document. Several factors are currently utilized to determine the number of cooks authorized each unit. These include: the unit's overall field feeding support plan, the total number of Soldiers supported by unit kitchens; the type and quantity of field feeding section equipment to include kitchens, sanitation centers, prime movers, and water trailers. The current methodology and criteria for determining unit level cook authorizations are detailed in the U.S. Army Force Management Support Agency document - MARC Study Document (MSD) for Food Service (Cook) Operations (May 1999). The resulting methodology and criteria documented in this study was based primarily on Subject Matter Expert (SME) input and a limited 6 meal periods of work measurement data to include 2 meal periods for 1 kitchen supporting 600 Soldiers and 4 meal periods for another kitchen supporting about 750 Soldiers.

Current unit cook position authorization criteria include 2 fixed components plus a variable component. The 2 fixed components include one Supervisor position (or Food Service Operations Sergeant) plus 1940 annual work hours to cover kitchen supply activities. The 1940 work hours equates to about ½ cook position and the MARC Study document does not indicate whether these 1940 hours cover on-site kitchen supply activities, cook hours away from the kitchen to pick and deliver required kitchen supplies, or both supply activities. The variable unit level cook workload component involves an equation that is dependent on the total number of Soldiers supported and the types and quantities of field feeding section equipment authorized. This equation estimates the annual work hours for all other unit cook MOS (Military Occupational Specialty) specific work activities to support unit field feeding operations. For a battalion level kitchen supporting 700 Soldiers, about 80% of the estimated total kitchen workload represents the variable workload associated with the number of Soldiers supported and less than 5% is due to the types and quantities of equipment authorized.

The variable workload component and 1940 supply work hours are converted into authorized cook positions based on an annual manpower availability factor (AMAF) per cook position for performing actual cook Military Occupational Specialty (MOS) work duties. The annual AMAF for performing MOS duties depends on the unit's Manpower Requirements Code (MARC). This is a 3 position code that identifies the type unit, unit location, and whether the unit is mobile or not. The same AMAF factor generally applies to all support MOS positions within a unit with some exceptions. The AMAF factors are calculated based on the assumption of 12 total available work hours per authorized position per day, or 4380 total available work hours per year. From this total available work hour factor is subtracted expected work hours associated with other collateral non MOS-related work duties. Examples of these include personal activities, unit security or guard details, packing and loading of equipment for unit movements, etc. The expected number of hours for these non MOS duties depends on each units MARC. The resulting amount estimates the available average work hours per authorized position for actual MOS related duties, and is the number utilized to convert unit cook work hour

requirements into authorized unit cook positions. For divisional combat units or the new Brigade Combat Teams, cooks are assigned to units with MARC Codes 21A or 31A. For these units, the AMAF factor for available hours for MOS duties is 3272 hours per year or 9.0 hours per day per cook position. This is the lowest AMAF factor across all MARC codes. For other unit MARC codes, the representative AMAF are higher and range from 3836 per year or 10.5 hours per day for similar Corp level units, and 4380 per year or 12.0 hours per day for Echelon Above Corp (EAC) units. Given these differences in AMAF per authorized position, brigade/division units will require more cooks than same size corps units, and corps units will require more cooks than same size EAC units. Based on the AMAF factors, brigade/division units will be authorized (12/9) 133% and corps units will be authorized (12/10.5) 114% of the authorized cook positions for a same size EAC unit.

Updated Authorized Cook Staffing Criteria

For direct comparison with the current unit cook authorization criteria, the recommended updated staffing criteria for unit kitchens includes a fixed authorization of 2 food service positions plus a variable authorization dependent only on the total number of Soldiers supported by the unit kitchen. The 2 fixed positions include 1 Supervisor position (or Food Service Operations Sergeant) plus 1 cook position to cover time away from the kitchen to pick up and return any kitchen supplies to include subsistence, water, and fuel. This compares to the current authorization criteria of 1 Supervisor position and about ½ cook position.

In determining TOE positions, the AMAF factor for supervisor positions for all units is 4,380 hours per year or 12 hours per day. For the collected work sampling data, the Supervision task was the only work task allocated to the Supervisor worker category. All other work tasks and associated hours were allocated to the cook or KP worker categories. Based on the work sampling data results (see Table 3), the average on-site kitchen supervision work hours ranged from 0.0 to 5.0 hours per meal period depending on kitchen, and averaged only 1.7 hours across all of the kitchens and meal periods. For the max 2 group meals per day, this equates to a range of 0.0 to 10.0 hours per kitchen per day, and on average only 3.4 on-site kitchen supervision work hours per day across all kitchens and meal periods. As a result, with 1 Supervisor position per kitchen, significant residual available supervisory work hours are available to cover those supervisory work activities performed away from the direct kitchen area and not captured and reflected in the work sampling data. Examples of these other supervisor work activities include: generate unit subsistence orders, complete necessary paperwork, unit meetings, etc.

The proposed updated cook staffing criteria includes 1 full cook position to cover cook work hours expended away from the kitchen site to pick up and return required kitchen supplies to include rations, water, and fuel. This equates to 2 cooks expending ½ of their workday away from the kitchen for re-supply functions. Cook work hours expended for on-site supply activities to include unloading/storing or received supplies,

inventorying or issuing supplies, etc where captured and reflected in the on-site work sampling data. As a result, the proposed kitchen staffing model provides additional cook work hours to cover the on-site kitchen supply activities. The current cook staffing criteria identifies only 1940 cook work hours for supply activities. This equates to about ½ man-hear depending on the units actual MARC Code. The associated MARC Study Document does not indicate if these work hours cover - only on-site kitchen supply activities, only away from kitchen work hours to pick and deliver required kitchen supplies, or both activities. As a result, the proposed cook staffing criteria identifies significant more work hours to cover kitchen supply functions. With current division force structures, field kitchens pickup and deliver their own subsistence supplies from ration break points. For the new Brigade Combat Team structures, planned logistic concepts include direct Class I delivery by brigade transportation assets to unit field kitchen locations. For these units, the need for 1 cook position to cover away from kitchen supply activities would be eliminated and the resulting proposed kitchen staffing levels reduced by one position.

As previously discusses, the 3 component cook workload model with 100% on-site feeding was selected as the "best" model to estimate overall kitchen work loads associated with all other cook MOS work activities. For grouped similar size kitchens (Table 5), this model very accurately predicted observed average cook workloads per meal period. For the updated staffing model, the 100% on-site feeding workload was selected because it represents the peak cook workloads and all units will at least sometimes feed all Soldiers on-site for extended time periods. As a result, authorized unit cook positions need be sufficient to cover these peak extended average workloads. The resulting peak variable cook workload equation (Equation 6) simplifies and includes a fixed component and a single variable - total Soldiers supported. All work sampling data was collected and analyzed on a per meal basis. Since Army units are equipped and staffed for a 2 hot meal per day capability, the per meal cook workload equation (Equation 6) most be multiplied by 2 to estimate the required available daily cook work hours to cover all cook kitchen work activities other than supervision and off-site re-supply hours. The resulting required daily cook work hour equation for these other cook MOS work activities is:

$$\text{Cook Hours} = 21.2690 + 0.0886*\text{TOT} \quad \text{[Equation 7]},$$

where TOT equals the total number of Soldiers supported or fed.

For the updated unit kitchen staffing model, these required available cook work hours need be converted to required cook positions and added to the 2 fixed cook positions to cover the kitchen supervisor and off-site kitchen supply functions. The resulting proposed updated unit level cook staffing model is:

$$\text{Authorized Cooks} = 2 + 21.2690/\text{DMAF} + 0.0886*\text{TOT}/\text{DMAF} \quad \text{[Equation 8]},$$

where DMAF equals the daily man-hour availability factor per authorized cook position for cook MOS work activities, and as before TOT equals the total number of Soldiers

supported by the kitchen. The DMAF is calculated by dividing the units annual AMAF factor by 365 to convert it to a daily factor.

The MARC code for division combat battalion or BCT units with field feeding sections is typically 21A or 31A. Based on the May 99 MARC Study Document for Food Service (Cook) Operations, the representative AMAF for cook positions for both of these MARCS is 3273 hours. This includes an adding back of hours normally deducted for KP duty for other MOS's. This equates to a DMAF of on average 8.96 available cook work hours per cook position per day (i.e. 8.96 = 3273/365). The resulting updated unit level cook staffing model for MARC Code 21A/31A units is:

Authorized Cooks [21A/31A] = 4.3738 + 0.0099*TOT [Equation 8].

The resulting updated cook staffing model for units with MARC Codes 21A or 31A is a fixed staffing component of 4.3738 cook positions for all field kitchens plus a variable incremental staffing component of 0.0099 cook positions per Soldier supported. The variable staffing component equates to 1 additional cook position for every 101 supported Soldiers. Equation 8 assumes that 100% of the AMAF hours represent actual productive MOS duty work hours. The issue of productive versus non-productive work hours is discussed further below.

Comparison of Current and Updated Cook Staffing Levels

To insure the proposed cook staffing levels are more than adequate to support any potential workload, the updated model is based on the maximum workloads associated with 100% on-site feeding, and in addition assumes 100% of the observed work hours for all tasks other than the KP only pot/pan sanitation and rubbish removal represented cook only work hours. For example for the on-site supply tasks, KPs are typically utilized to offload and store received supplies. Also for the serving task, KPs are often utilized for some serving activities such as monitoring and replenishing the external cold or self-serve line with salads, fruits, shelf serve items, and hot/cold beverages. However in developing the updated staffing model, 100% of the workload for these tasks are assumed to be cook only work hours.

Table 8 details the cook staffing levels for MARC Code 21A/31A units based on the Army's current cook MOS staffing model and the proposed updated cook MOS staffing model for unit kitchens supporting from 175 to 925 Soldiers. The current cook staffing levels are from the May 99 MARC Study Document for Food Service (Cook) Operations (Table 11-5B). These staffing levels assume that 100% of the AMAF hours represent actual productive MOS hours. For the updated staffing model, 2 sets of staffing levels are presented. The lower set is also based on 100% of AMAF hours represent productive MOS hours while the higher set assumes only 80% of available AMAF hours represent productive MOS hours and 20% of the AMAF hours represent non-productive or down time. In reviewing AR 71-12 Force Development and Documentation for establishing authorized positions, there is no mention if 100% of the AMAF hours for MOS duties are assumed to represent actual productive MOS work hours or if some per

cent are assumed to represent non-productive work hours due to variations in kitchen workloads or other factors. Follow-up discussions with USAFSMA manpower specialists indicated that 100% of the listed AMAF hours are assumed to represent actual productive MOS work hours in developing TOE authorizations.

Table 8. Comparison of Current and Updated Model Cook Staffing Levels (for MARC Code 21A/31A Units)

Total Supported Population	Unit Kitchen Cook Staffing Levels		
	Current Staffing Model	Updated Staffing Model	
		(100% Prod)	(80% Prod)*
175	6	6.1	7.1
225	7	6.6	7.8
275	8	7.1	8.4
325	9	7.6	9.0
375	11	8.1	9.6
425	12	8.6	10.2
475	13	9.1	10.8
525	14	9.6	11.5
575	15	10.1	12.1
625	16	10.6	12.7
675	17	11.1	13.3
725	19	11.6	13.9
775	20	12.0	14.6
825	20	12.5	15.2
875	21	13.0	15.8
925	22	13.5	16.4

As detailed in Table 8, the updated cook staffing model generates similar cook authorizations at the lower feeding levels and significantly reduced authorizations at the higher feeding strengths. For kitchens supporting 175 Soldiers, both the current criteria and the updated staffing model result in an authorization of 6 cook positions with 100% productive AMAF hours. However as the number of supported Soldiers increase, the staffing levels diverge with the updated model generating reduced authorizations. For example for supporting 375, 575, and 775 Soldiers, current cook kitchen cook authorizations are 11, 15, and 20 respectively. With the updated staffing model and also 100 productive AMAF hours, the recommended staffing levels are 8, 10, and 12, which equates to significant reductions 3, 5, and 8 cook positions respectively. The potential cook position reductions are still significant if with the updated model only 80% of the AMAF hours represent productive cook MOS work hours.

As the number Soldiers supported increases, the difference between current staffing levels and the lower updated cook model staffing levels continue to increase. This is because incremental cook staffing is about 1 cook per 50 supported Soldiers with the current cook staffing model and a much lower 1 extra cook per 100 Soldier for the updated cook staffing model.

The updated cook staffing model results confirm the analysis and findings detailed in the prior Natick Technical Report TR-05/004 Army Field Kitchen Workloads and Fuel Consumption, December 2004. This report included a detailed review and assessment of the work sampling data results utilized to develop the updated cook staffing model in this report, and a detailed comparison of the data with historical work sampling results for Army field kitchens with the prior group "A" and "B" rations and former M-2 burner. A key finding in that report was that Army field kitchens supporting 900 Soldiers with the new Unitized Group Rations and MBU burner units significantly reduced overall kitchen workloads by about 7 cook positions as compared to prior field kitchens with group "A" and "B" rations and M-2 burners.

Conclusions and Findings

Primary findings and conclusions include:

- The proposed updated unit cook staffing model was developed based on work sampling data covering a wide cross section of Army field feeding situations to include: small to medium to large Army field kitchens, onsite and remote site feeding mixes from 100% on-site to 100 remote site, both MKT and CK kitchens, and for mostly UGR-A rations and some UGR-H/S rations.

- For the updated staffing model, required unit cook work hours were estimated on the high side to insure resulting proposed cook staffing levels are more than adequate to cover any potential workloads. This includes estimating required cook hours based on an assumed 100% on-site feeding mix as this generates the maximum required cook work hours as compared to any mix with some to all remote site meals, and by assuming 100% of all observed productive work hours other than those for KP only tasks pot/pan sanitation and rubbish removal represented cook only work hours even though some of these tasks included KP work efforts. For example, relative the on-site supply task KPs are typically utilized to unload and store received subsistence supplies. However for the updated cook staffing model all of these hours and hours for other tasks like serving were assumed to be cook only work hours.

- Based on the updated staffing model, current cook staffing levels are accurate for smaller kitchens but to high for larger battalion kitchens with increasing differences as the number of Soldiers supported increases. For divisional combat battalion or Brigade Combat Team (BCT) field kitchens (MARC Codes 21A/31A), the current authorized cook positions for field kitchens supporting 175, 525, and 875 Soldiers each are 6, 15, and 21 respectively. For these same size kitchens, the updated staffing model results in cook staffing levels of 6, 10, and 13 respectively. While the updated staffing model results in the same cook staffing level for kitchens supporting 175 Soldiers, the updated cook model results in a reduction of 5 cook positions (15 to 10) for kitchens supporting 525 Soldiers, and 8 cook positions (21 to 13) for kitchens supporting 925 Soldiers.

- The updated cook staffing model results/findings are similar to those detailed in the prior Natick Technical Report TR-05/004 Army Field Kitchen Workloads and Fuel Consumption, December 2004. That report indicates that for field kitchen's supporting 900 Soldiers, the UGR rations and MBU burners reduced daily kitchen food preparation and burner workloads by about 7 cook positions as compared to earlier field kitchens with the more labor intensive group A/B rations and M-2 burners. These savings are similar to the reduced cook staffing levels generated by the updated cook staffing model which for kitchens supporting 875 Soldiers generates a reduction of 8 cook positions (21 to 13).

- Current Army cook authorization criteria do not appear to reflect the significant workload reductions provided by the newer labor saving UGR-A and UGR-H/S rations and MBU.

This document reports research undertaken at the U.S. Army Research, Development and Engineering Command, Natick Soldier Center, Natick, MA, and has been assigned No. Natick/TR-06/008 in a series of reports approved for publication.

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Appendix

Detailed Work Sampling Data by Kitchen and Meal Period

Table A1. Detailed Kitchen Workloads by Meal Period

Kitchen Data								Productive Work Hours by Task												Totals	
No.	Type	Type Ration	Meal/Menu	Remote Sites	On-site	Total Remote Meals	Total Meals	Food Prep	Serving	Supervision-S	Other Food Service	Other Non Food Service	Remote Feeding	Kitchen Sanitation	Pot/Pan Sanitation-KP	Rubbish Removal-KP	Supply	Burner Maint/Repair	Gen/Other Maint.	Total Prod Work Hours	Cook Hrs excl Supervision
9	KCL	UGR-H/S	D	0	100	0	100	2.8	1.5	0.3	0.5	0.5	0.0	0.0	1.3	0.3	0.3	0.0	0.0	7.3	5.5
9	KCL	UGR-H/S	D	0	100	0	100	2.0	2.0	0.0	0.8	0.0	0.0	0.0	0.5	0.3	0.0	0.0	0.0	5.5	4.8
9	KCL	UGR-H/S	Ave	0	100	0	100	2.4	1.8	0.1	0.6	0.3	0.0	0.0	0.9	0.3	0.1	0.0	0.0	6.4	5.1
8	KCL	UGR-A	D	0	100	0	100	4.0	1.8	0.0	0.0	1.0	0.0	0.8	1.3	0.3	0.3	0.3	0.0	9.5	8.0
8	KCL	UGR-A	D	0	100	0	100	3.0	2.0	0.0	1.0	0.0	0.0	0.8	1.3	0.3	0.5	0.8	0.0	9.5	8.0
8	KCL	UGR-A	Ave	0	100	0	100	3.5	1.9	0.0	0.5	0.5	0.0	0.8	1.3	0.3	0.4	0.5	0.0	9.5	8.0
5	MKT	UGR-A	B9	4	0	150	150	7.0	0.0	1.5	2.3	1.0	1.3	1.5	3.3	0.3	1.3	0.3	0.3	19.8	14.8
5	MKT	UGR-A	B10	4	0	150	150	5.3	0.0	0.8	2.3	0.5	2.3	1.0	4.5	0.0	2.0	0.3	0.3	19.0	13.8
5	MKT	UGR-A	D10	4	0	150	150	7.0	0.0	3.0	2.0	1.0	1.8	0.5	6.8	0.5	2.0	0.8	1.0	26.3	16.0
5	MKT	UGR-A	D12	4	0	150	150	5.3	0.0	2.3	3.5	2.5	2.0	1.3	6.3	0.3	2.0	0.8	1.0	27.0	18.3
5	MKT	UGR-A	Ave	4	0	150	150	6.1	0.0	1.9	2.5	1.3	1.8	1.1	5.2	0.3	1.8	0.5	0.6	23.0	15.7
4	MKT	UGR-A	B2	1	140	60	200	7.5	2.0	1.5	2.5	1.0	1.0	2.5	2.0	0.3	1.3	0.3	0.5	22.3	18.5
4	MKT	UGR-A	B4	1	140	60	200	5.3	3.5	0.8	1.5	0.8	1.8	2.0	2.8	0.0	2.0	0.3	0.3	20.8	17.3
4	MKT	UGR-A	D3	1	140	60	200	7.5	3.5	3.0	2.5	1.0	1.0	0.0	4.0	0.5	2.0	0.5	0.8	26.3	18.8
4	MKT	UGR-A	D5	1	140	60	200	5.0	2.8	2.3	3.0	2.0	1.5	1.5	4.3	0.3	2.0	1.0	1.0	26.5	19.8
4	MKT	UGR-A	Ave	1	140	60	200	6.3	2.9	1.9	2.4	1.2	1.3	1.5	3.3	0.3	1.8	0.5	0.6	23.9	18.6
7	MKT	UGR-A	B4	3	108	92	200	5.8	1.0	1.5	1.3	0.8	1.0	3.3	4.0	0.8	0.3	0.0	0.0	19.5	13.3
7	MKT	UGR-A	D5	3	108	92	200	6.5	2.0	0.8	0.0	0.5	0.5	0.8	3.5	0.3	1.0	0.5	0.0	16.3	11.8
7	MKT	UGR-A	Ave	3	108	92	200	6.1	1.5	1.1	0.6	0.6	0.8	2.0	3.8	0.5	0.6	0.3	0.0	17.9	12.5

Table A1 (cont'd). Detailed Kitchen Workloads by Meal Period

Kitchen Data								Productive Work Hours by Task											Totals	
No.	Type	Type Ration	Meal/Menu	Remote Sites	On-site	Total Remote Meals	Total Meals	Food Prep	Serving	Supervision-S	Other Food Service	Other Non Food Service	Remote Feeding	Kitchen Sanitation	Pot/Pan Sanitation-KP	Rubbish Removal-KP	Supply	Burner Maint/Repair	Gen/Other Maint.	Total Prod Work Hours	Cook Hrs excl Supervision
13	MKT	UGR-A	D	0	350	0	350	10.5	5.8	5.0	1.0	3.0	0.0	1.5	8.5	0.5	1.5	0.8	0.3	38.3	24.3
13	MKT	UGR-A	B4	0	350	0	350	8.8	5.8	5.0	1.3	1.8	0.0	2.0	5.8	1.0	0.5	0.5	0.3	32.5	20.8
13	MKT	UGR-A	D9	0	350	0	350	10.8	9.3	4.5	1.3	2.5	0.0	1.0	6.5	0.8	1.8	0.8	0.3	39.3	27.5
13	MKT	UGR-A	B5	0	350	0	350	10.3	6.3	3.3	1.5	1.8	0.0	2.5	9.8	0.5	1.0	0.8	0.3	37.8	24.3
14	MKT	UGR-A	Ave	0	350	0	350	10.1	6.8	4.4	1.3	2.3	0.0	1.8	7.6	0.7	1.2	0.7	0.3	36.9	24.2
14	MKT	UGR-A	D	0	400	0	400	12.0	9.3	0.8	0.0	2.8	0.0	2.0	8.8	1.3	6.3	2.5	0.0	45.5	34.8
14	MKT	UGR-A	B4	0	400	0	400	13.8	9.0	1.5	0.5	1.3	0.0	4.5	8.8	2.3	1.0	0.5	0.0	43.0	30.5
14	MKT	UGR-A	D9	0	400	0	400	16.3	10.5	0.3	1.0	0.5	0.0	4.3	9.0	1.8	8.0	0.0	0.0	51.5	40.5
14	MKT	UGR-A	D5	0	400	0	400	13.3	11.5	0.0	0.3	0.5	0.0	4.8	8.5	2.0	2.8	0.8	0.0	44.3	33.8
15	MKT	UGR-A	Ave	0	400	0	400	13.8	10.1	0.6	0.4	1.3	0.0	3.9	8.8	1.8	4.5	0.9	0.0	46.1	34.9
2	MKT	UGR-A	D6	2	325	75	400	7.5	3.5	2.0	2.0	2.3	1.0	3.3	9.5	0.0	1.8	0.5	0.0	33.3	21.8
2	MKT	UGR-A	D	2	325	75	400	6.5	3.3	0.0	1.5	0.0	0.5	1.3	8.5	1.5	1.3	0.5	0.3	25.0	15.0
2	MKT	UGR-A	Ave	2	325	75	400	7.0	3.4	1.0	1.8	1.1	0.8	2.3	9.0	0.8	1.5	0.5	0.1	29.1	18.4
1	MKT	UGR-A	B	8	83	617	700	22.3	0.5	0.0	0.0	0.0	2.8	1.8	15.3	2.3	1.5	0.0	0.0	46.3	28.8
1	MKT	UGR-A	B7	7	128	572	700	17.5	2.3	0.0	0.0	0.0	4.8	0.0	16.8	1.3	1.8	0.5	0.0	44.8	26.8
1	MKT	UGR-A	D3	7	153	547	700	15.5	1.3	1.8	0.8	2.0	2.5	2.3	16.3	0.0	1.3	1.5	0.3	45.3	27.3
1	MKT	UGR-A	D6	7	113	587	700	10.5	2.0	0.8	1.5	1.8	3.5	2.3	9.8	1.3	1.3	1.3	1.0	36.8	25.0
1	MKT	UGR-A	Ave	7	119	581	700	16.4	1.5	0.6	0.6	0.9	3.4	1.6	14.5	1.2	1.4	0.8	0.3	43.3	26.9
3	MKT	UGR-A	D	8	185	665	850	19.0	0.5	0.0	0.0	0.0	3.0	1.8	16.8	1.5	4.3	0.3	0.0	47.0	28.8
3	MKT	UGR-A	D10	8	90	760	850	11.8	1.3	0.3	1.8	2.0	2.8	2.0	18.5	0.8	0.0	0.0	0.0	41.0	21.5
3	MKT	UGR-A	Ave	8	137	713	850	15.4	0.9	0.1	0.9	1.0	2.9	1.9	17.6	1.1	2.1	0.1	0.0	44.0	25.1

Table A1 (cont'd). Detailed Kitchen Workloads by Meal Period

Kitchen Data								Productive Work Hours by Task												Totals	
No.	Type	Type Ration	Meal/Menu	Remote Sites	On-site	Total Remote Meals	Total Meals	Food Prep	Serving	Supervision-S	Other Food Service	Other Non Food Service	Remote Feeding	Kitchen Sanitation	Pot/Pan Sanitation-KP	Rubbish Removal-KP	Supply	Burner Maint/Repair	Gen/Other Maint.	Total Prod Work Hours	Cook Hrs excl Supervision
6	MKT	UGR-A	D2	10	235	765	1000	16.8	2.3	1.8	2.8	2.5	4.8	3.8	21.3	1.3	5.3	0.3	0.8	63.3	39.0
6	MKT	UGR-A	D4	10	235	765	1000	22.5	1.8	1.8	2.0	1.0	5.5	2.8	17.5	0.5	0.5	1.0	0.5	57.3	37.5
6	MKT	UGR-A	D5	9	147	853	1000	12.5	0.0	4.5	2.5	2.5	5.3	5.0	21.3	2.8	2.8	2.5	0.5	62.0	33.5
6	MKT	UGR-A	D6	9	122	878	1000	18.0	0.3	2.0	0.5	2.0	3.8	1.5	20.0	1.3	0.0	0.5	0.5	50.3	27.0
6	MKT	UGR-A	Ave	10	185	815	1000	17.4	1.1	2.5	1.9	2.0	4.8	3.3	20.0	1.4	2.1	1.1	0.6	58.2	34.3
11	CK	UGR-A	D14	4	205	345	550	15.5	5.0	5.0	6.5	0.0	2.3	2.3	15.0	0.8	2.3	0.8	0.0	55.3	34.5
15	CK	UGR-A	D6	0	650	0	650	22.5	12.3	1.5	1.5	1.8	0.0	2.8	10.8	4.3	4.0	0.5	0.0	61.8	45.3
15	CK	UGR-A	D	0	650	0	650	15.3	14.8	5.0	1.5	0.0	0.0	0.5	6.5	1.8	6.8	0.0	0.0	52.0	38.8
15	CK	UGR-A	Ave	0	650	0	650	18.9	13.5	3.3	1.5	0.9	0.0	1.6	8.6	3.0	5.4	0.3	0.0	56.9	42.0
10	CK	UGR-H/S	D2	0	700	0	700	14.0	5.8	2.5	1.3	3.8	0.0	1.5	16.5	1.0	3.0	0.3	0.5	50.0	30.0
10	CK	UGR-A	B4	0	700	0	700	17.3	6.5	2.5	2.0	6.0	0.0	10.5	16.8	0.8	3.0	0.5	0.0	65.8	45.8
10	CK	Both	Ave	0	700	0	700	15.6	6.1	2.5	1.6	4.9	0.0	6.0	16.6	0.9	3.0	0.4	0.3	57.9	37.9
12	CK	UGR-H/S	D	4	425	275	700	14.5	5.5	0.0	0.0	0.0	1.0	1.5	16.3	0.5	0.0	0.3	0.0	39.5	22.8
12	CK	UGR-A	B	4	425	275	700	11.8	7.0	0.0	2.8	0.0	1.0	4.0	14.8	2.8	0.0	0.0	0.0	44.0	26.5
12	CK	Both	Ave	4	425	275	700	13.1	6.3	0.0	1.4	0.0	1.0	2.8	15.5	1.6	0.0	0.1	0.0	41.8	24.6
16	CK	UGR-A	D8	0	850	0	850	29.3	10.0	8.0	0.0	2.8	0.0	7.8	18.8	7.0	2.3	0.3	0.0	86.0	52.3
16	CK	UGR-A	D7	0	850	0	850	32.0	10.5	1.5	3.8	3.3	0.0	2.8	11.0	3.8	7.8	0.5	0.0	76.8	60.5
16	CK	UGR-A	Ave	0	850	0	850	30.6	10.3	4.8	1.9	3.0	0.0	5.3	14.9	5.4	5.0	0.4	0.0	81.4	56.4
17	CK	UGR-A	D9	0	1700	0	1700	40.3	28.5	0.0	0.0	0.0	0.0	5.3	14.8	10.0	12.5	0.0	0.0	111.3	86.5
17	CK	UGR-A	D	0	1700	0	1700	38.8	21.8	2.5	5.3	1.0	0.0	7.8	24.5	6.0	3.3	0.5	0.0	111.3	78.3
17	CK	UGR-A	Ave	0	1700	0	1700	39.5	25.1	1.3	2.6	0.5	0.0	6.5	19.6	8.0	7.9	0.3	0.0	111.3	82.4

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List of Acronyms

AFFS	Army Field Feeding System
AMAF	Annual Manpower Availability Factor (Hours)
BCT	Brigade Combat Team
CK	Containerized Kitchen
EAC	Echelon Above Corp
FTX	Field Training Exercise
KCLFF-E	Kitchen Company Level Field Feeding - Enhanced
KP	Kitchen Police
MARC	Manpower Availability Factor
MBU	Modern Burner Unit
MKT	Mobile Kitchen Trailer
MOS	Military Occupational Specialty
MSD	MARC Study Document
SBCT	Stryker Brigade Combat Team
SME	Subject Matter Expert
TOE	Table of Organization and Equipment
UGR-A	Unitized Group Ration - A
UGR-H/S	Unitized Group Ration - H/S