

Analysis of Potential Improvement in Karni Performance

1. The potential throughput for exports at Karni was examined from two perspectives: top down and bottom up. The first was based on cargo handling norms which would be expected at a good cargo handling operation such as might be seen in Malaysia, Thailand or Pakistan. The second was based on an industrial engineering survey of the performance at Karni conducted by Paltrade on the Palestinian side of the border. These two efforts were prepared by professionals experienced with these types of operations assisted by experts familiar with scanning activities. The analysis was conducted without the benefit of measuring the operations on the Israel side of the border or with a thorough discussion on the current security requirements. Indeed, efforts to link the operating efficiencies to security requirements have proven difficult.

Top Down Analysis

2. The discussion on Karni's capacity for handling export cargo has so far focused on productivity based on truck loads. This is somewhat deceptive as the size of the trucks varies. Similarly, a discussion of pallets throughput is deceptive because of the requirement that standard pallets be reduced in size to uneconomical units. This analysis begins with the assumption that most of the trucks are 6-8 wheel trucks with standard pallets (1.1 x 1.1 meter) and that a typical truck will have 10-18 foot cargo area, holding 2x3 up to 2x5 pallets stacked 2-3 high. The unloading of this vehicle with a proper cross-docking operation would take 15-30 minutes to offload and restack. With a side opening or flat bed configuration, a single forklift operating on the ground should be able to offload this in 10-30 minutes. The result is a pallet handling productivity of between 1-1.5 minutes per move. The longer time assumes that the forklifts would handle a single pallet at a time. Thus for this range of trucks, the unloading time would be 30 minutes or less. Allowing for setup time, this would be at the most 40 minutes but should average about 30 minutes. With larger trucks, e.g. a 20' or 40' ISO container, the times would be similar but the operation would require two forklifts.

3. Scanning rates vary depending on the operation. A continuous pass through system, e.g. luggage or production line scanner would require 15 seconds or less per unit inspected. A single pallet, non-continuous scan would require 30-45 seconds. The scanner should not represent the operating constraint in a single forklift operation, even without a cross-dock operation. Thus the average throughput time for a pallet scanner fed by a forklift should be 1 minute or less.

4. Assuming only a two-shift operation, the throughput for a scanner channel should average about 750 allowing for shift breaks and unexpected delays. If a typical truck had 20 pallets, this would amount to 37 trucks per channel. For a chamber in which the pallets were unloaded, inspected and loaded back, the time required would average less than one hour per truck. Assuming an inspection time of ½ hour, and that two trucks could be processed simultaneously, the throughput for a two-shift operation would average about 18 trucks.

5. The implications of a top down analysis of a 7 scanner, 6 chamber operation are that a peak throughput of 360 trucks should be possible implying an average throughput on the order of 260 trucks per day allowing for fluctuations in demand and unplanned shutdowns

Bottom Up Analysis

6. There has been a relatively steady decline in the throughput at Karni as shown in Figure 1. There are various explanations for this including increasingly strict security arrangements. The frequency of actual security events in recent has not been sufficient to explain this decrease, but the measures taken to avoid reoccurrences do. At the request of the Bank, Paltrade is performing a survey of the performance of the scanning cells at Karni. The results from a three week sample in July/August of 2005 were used to evaluate current performance. The measurements were of the turnaround of Palestinian trucks and thus do not provide detail on the events that occurred on the Israeli side. However, they do provide a set of basic performance measures which are more detailed than the simplistic numeraire, trucks per day, that has been used in discussions so far. What is missing from the following discussion is the other component of a process, queuing delays, which are particularly important in managing a supply chain

7. The survey data indicate that the average time for inspecting a truck using the pallet scanner is 1.82 hours. The average time per palette scanned is about 2.69 minutes but with significant variations (a standard deviation of 1.47 minutes). This is more than twice the time required for typical palette scanning operation. The difference can be partially explained by the current configuration of the transfer activity, whereby the unloading truck is separated from the scanner's conveyor by a distance of about 10 meters with a barrier in between. A single forklift truck is used to make the movement between the truck and scanner. However, observations of this operation have shown that the forklift movement is not the problem and that in general the forklift is waiting at the scanner for permission to place the palette on the conveyor.

8. These performance figures imply a medium sized truck with a total of 32 palettes could be unloaded in 1.43 hours, with a total turnaround time (allowing for positioning and preparing the truck) of 1.58 minutes. These results are somewhat misleading since the trucks are only 6-8 wheelers with about twice the number of palettes normally required because of arbitrary height limits. The basic sources of improvement would be reducing the scanning time, increasing the size of palettes and simplifying the transfer operation, e.g. extending the loading conveyor or shortening the distance between the truck and the conveyor. **With a reduction of scanning time to a very conservative 1.5 minutes, throughput would be increased by 66%. An increase in maximum palette size (see below) of 50% would increase throughput by at least 33%. The simplification of the transfer operation would complement the reduction in scanning time, and these combined improvements would increase throughput by 122%.**

9. The recorded daily availability of the 7 scanners is 94%¹. This is quite acceptable; a target availability for scanners of this age is 90%-95%. At the same time, the hours actually operated are only 72% of the scheduled hours. This is due to late opening, shutdowns of

¹ This is based on the assumption that any scanner operating less than 12% of the day is not available for that day and that the 7 scanners are the total available.

individual units during the day, and other unexplained sustained interruptions of scanner operation.² **A more reasonable target is 90%. This would increase throughput by 25%.**

10. The artificial limit on pallet height significantly below the scanner opening height of 1.78 meters is justified in terms of limitations on the .45 MeV scanners. For high density, tightly packed goods such as tomatoes or eggs, there appears to be a limit of 0.8 meters for the x-ray to penetrate. In heightened security situations, it can be argued that a tighter limit is required to improve resolution. However, this limit applies only to certain products and many others can be scanned at the full height. At present, the pallet height is also limited because there are no fixed, published rules which would allow shippers to normalize their operations. If this artificial restriction were eliminated, then there would be a substantial increase in throughput. **Assuming that the average maximum scanning height could be doubled and that half of the goods could take advantage of this, then the throughput of cargo (not pallets) could be increased by 50%.**

11. The remaining improvement is an increase in operating hours. Without labor conditions that prevent this increase or a persuasive security argument why it cannot be done, it is difficult to understand why this has not been enacted long ago.³ **A two shift operation of 16 hours allowing for a loss of ¼ hour during the shift over would increase the throughput by 55%. This would still allow for preventative maintenance during the third shift so any degradation of scanner reliability could be minimized, but it might drop back to 90% implying a net gain in throughput of only 50%.**

12. The baseline productivity for the scanners is estimated to be 25 trucks assuming 1.82 hours per truck and 95% availability of the 7 scanners during 72% of a weekday 9.5 hour operation. The suggested improvements are

- Increase shift hours +50%
- Actual operations at least 90% of scheduled operations +25%
- Increase and standardization of pallet scanning heights +33%
- More efficient scanner operations +66%

As these are multiplicative, the introduction of all improvements would provide a gain in throughput of 150% implying 100 trucks. This is only about half the estimate of the top down due to the conservative scanner throughput and more conservative height limitations on the pallets

13. In addition to the throughput which can be achieved using the scanners, there is the additional capacity provided by the inspection chambers. There has been no survey done of performance, but discussions with the operators indicate that the chambers can handle 2 or more trucks and that the typical unloading, inspection and loading times are 3 hours. With the increased operating hours, it should be possible to get a throughput of 10 trucks per chamber per

² It should be noted that during the period of measurement, there were no cessations of operations due to security concerns.

³ Ports have long ago moved to 24/7 as have the busier airports – indeed Fedex has a night-time cargo operation worldwide.

day. **Assuming 6 chambers are used for exports, this would add 60 trucks per day to Karni's capacity for export trucks.** Again this is only about ½ that of the top down approach as an exceptionally long time is provided for inspecting the cargo.

14. **The following analysis suggests a throughput without investment of 160 trucks per day.** It can be argued that the inspection time is too optimistic, even though it is very conservative by international standards. However there are means for improving throughput through the use of multiple scanning monitors and processing suspect palettes in a way that will not interfere with the general flow of goods

Sample Data Report for Scanner Bays

Bay	Actual working Hours	Planned Working Hours	Capacity Utilization (Actual/Plan)	No. of crossed Trucks	Average Hrs per truck.
10	5.00	9.50	53%	15	1.74
11	5.17	9.50	54%		
12	8.00	9.50	84%		
13	8.00	9.50	84%		
20	8.25	9.50	87%	16	1.54
21	8.25	9.50	87%		
22	8.17	9.50	84%		
Average	50.84	66.50	76%	31	1.64
23	8.17	14.00	58%	18	0.45
Average	59.01	80.50	73%	49	1.20

Bay 10 for textiles, canned food and miscellaneous. Bay 20 for miscellaneous, bay 23 for empties. Cells 7-9 uses for vegetables and scrap metal and cells 6 and 9A for scrap metal and wood. Cell 27 used for scrap metal.

Sample Data Sheet for Chambers

Chamber No.	Actual working Hours	Planned Working Hours	Capacity Utilization (Actual/Plan)	No. of crossed Trucks	Average Hrs per truck.
7,8,9	3.00	9.30	32%	3	1.00
6	6.20	9.30	67%	2	3.10
9A	7.25	9.30	78%	2	3.63
27	0.00	0.00	0%	0	0.00

Figure 1

Monthly Exports through Karni (Trucks/month)

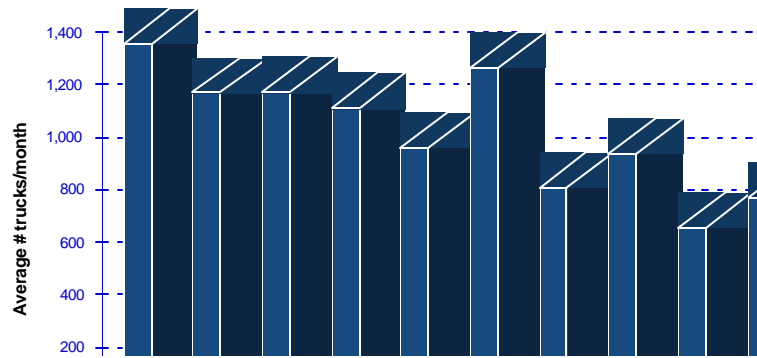


Figure 2

Distribution of Scanner Times

