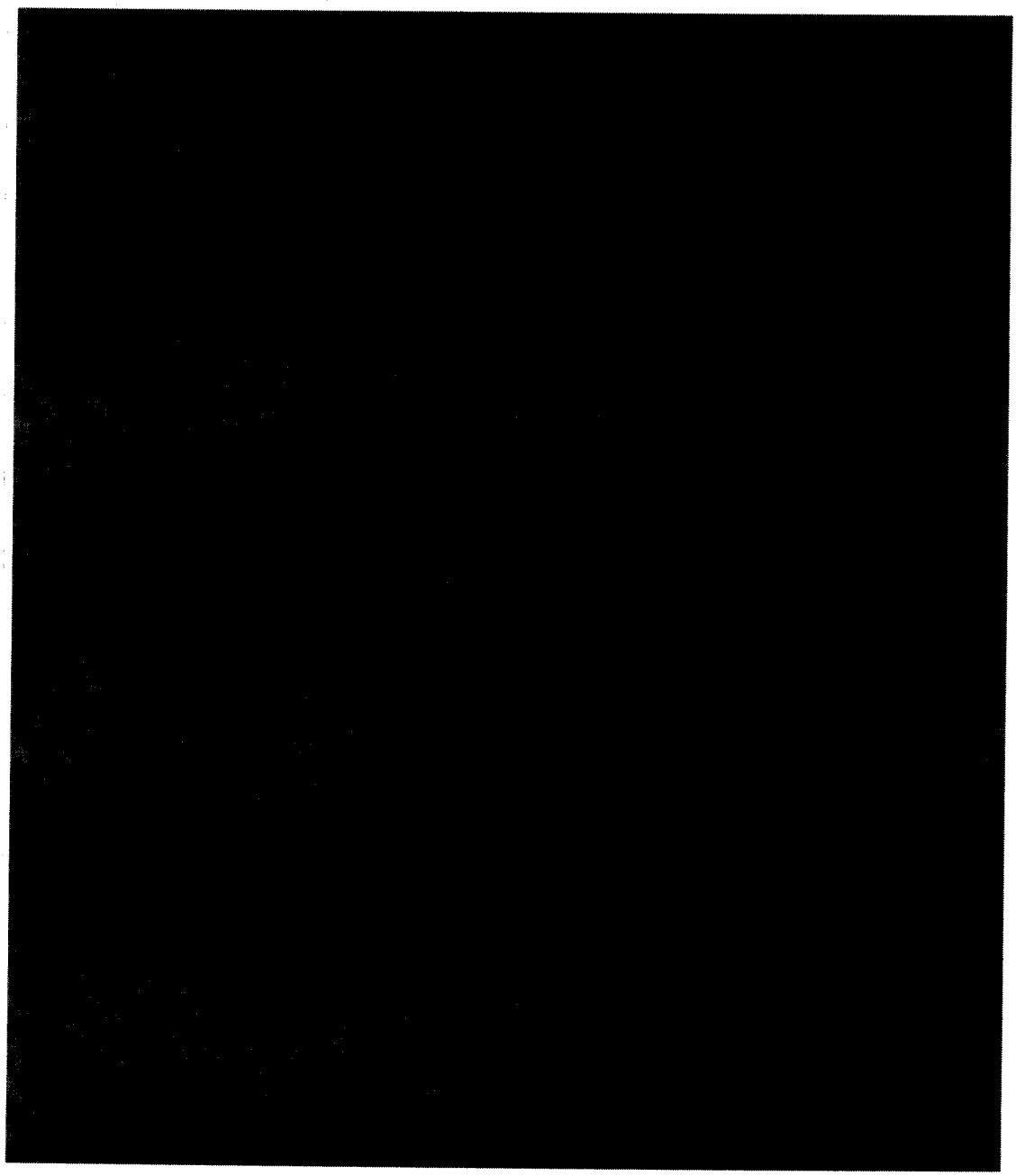

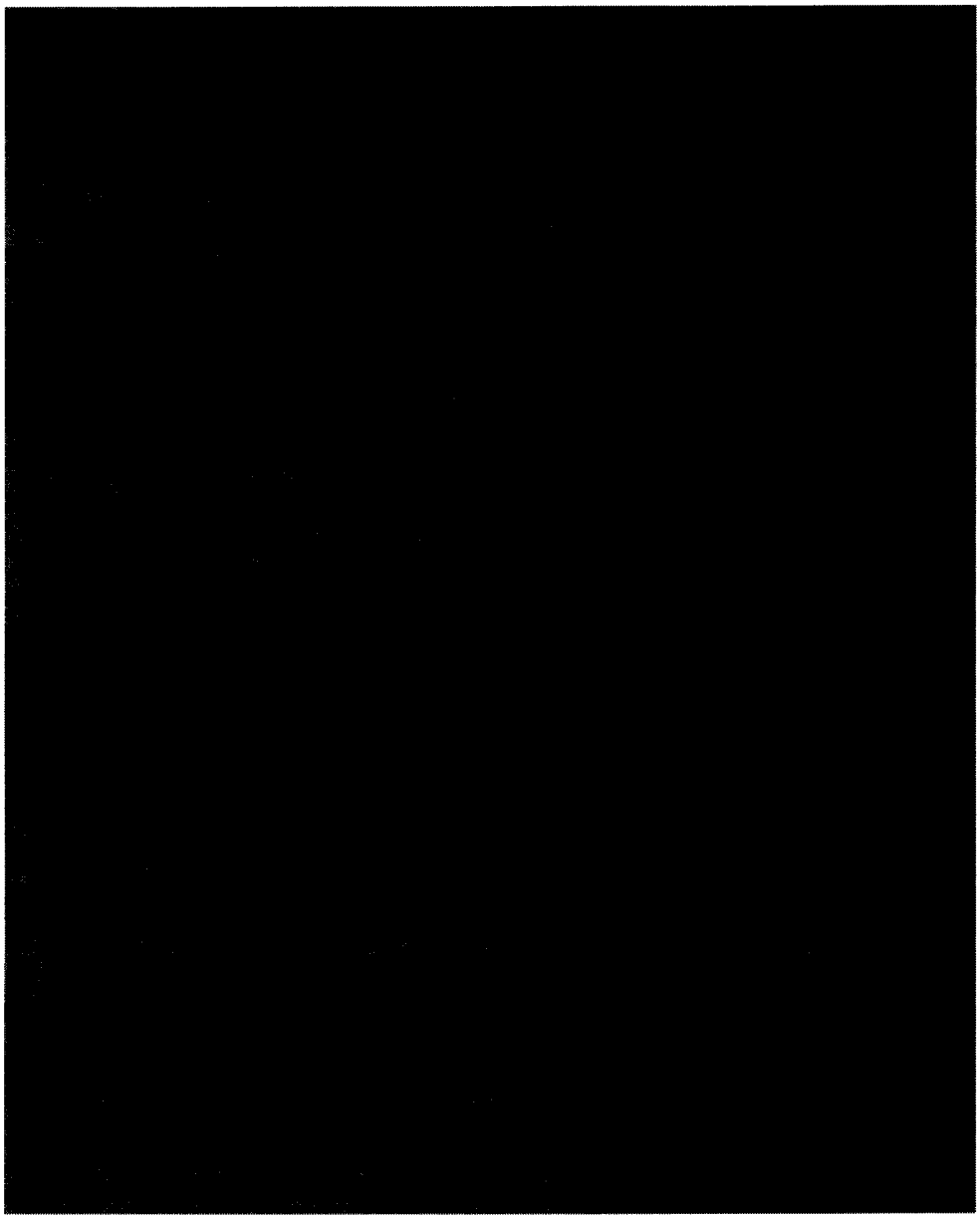

Some other results provided by historical studies:

(1) Newly identified stockpiles of bridging equipment had been present for years so they did not represent a sudden change in Soviet practices, subduing rumors of impending hostilities.

(2) A motorized rifle regiment in the Leningrad Military District was trained in air mobile tactics, allowing for more mobility than was previously expected. Previous coverages showed this capability to be common throughout the district.

(3) Collateral information showed that previously unidentified storage bunkers could be used to protect reserve grain from nuclear fallout as a civil defense measure. Reexamination of previous KH-9 coverages identified some 30 more bunkers, provided approximate dates of construction, and so allowed analysts to speculate what national events prompted the construction of the storage bunkers.

4.3 MC&G Collection Summary

The criteria for evaluating KH-9 imagery collection against MC&G requirements are contained in Table 4-9. One of the more significant parameters is the gross cloud-free square nautical miles returned by missions against validated MC&G requirements. Cloud-free assessment reports are generated on World Area Grid (WAG) cell (12 x 18 square nautical miles) and WAG subcell (3 x 3 square nautical miles) basis. Even though the information on individual cloud-free subcells is available,the size of the area reported is smaller than the minimum area required. Satellite image resolution requirements for MC&G purposes vary with the scale and type of the product. The most stringent requirements for ground resolution to meet image content needs of military MC&G products is 2 feet for 1:50,000 line maps and for DLMS Level II digital culture and terrain data. This is more important for the panoramic imagery than for the stellar terrain imagery. The KH-9 panoramic imagery taken at altitudes of 82-132 nautical miles (the range of altitudes for missions 1201 through 1212) meets and in many cases exceeds the MC&G requirements for ground resolution distance (GRD) or NIIRS. Similarly, KH-9 MCS frame imagery taken at 84-156 nautical miles (the range of altitudes for MCS operations on missions 1205 through 1212) will, for certain products, provide the required GRD. The remainder of this section presents coverage satisfaction statistics for the panoramic and stellar terrain camera systems in terms of cloud-free imagery.

4.3.1 Panoramic Collection Summaries for MC&G

The current USIB-approved KH-9 panoramic imagery requirements are for 22.4 million square nautical miles, shown in Table 3-1. Current satisfaction levels against these requirements are shown in Table 4-10. This table is based primarily on the actual KH-9 collection and excludes the Sino-Soviet area and most of the important search or point target areas in the Middle East, for which MC&G requirements are generally met.

TABLE 4-10

SUMMARY OF KH-9 PANORAMIC MC&G COVERAGE FOR NON-COMMUNIST AREAS
(Stereo, 90% Cloud Free)

	(Millions of Cloud-Free Square N.M.)		
	Original Requirement	Area Collected By Dec 1976	Remaining Requirement
Military			
First Time (FY 72-77)	6.8	3.2	3.6
Recoverage (FY 72-78)	13.5	6.9	6.6
Subtotal	20.3	10.1	10.2
Civil			
First Time (FY 72-78 @ 0.3 msnm per year)	2.1	0.9	1.2
Total	22.4	11.0[1]	11.4

[1] Includes KH-4 coverage of 2.1 million square nautical miles collected in FY 1972. This figure includes 0.5 million square nautical miles of first-time coverage and 1.6 million square nautical miles of recoverage.

4.3.3 Exploitation

An overview of the DMA production process is portrayed in Figure 4-18. These processes are built on the assumption of the continued availability of both panoramic (wide area coverage) and frame imagery (high metric accuracy) as basic input. The output is a complete spectrum of DMA products, many of which are currently in a digital form. Advances in autocartography, for example, have made possible the extraction of mapping data from film imagery in digital form, and the subsequent generation of maps and charts from this digital data base. Proven reductions in project pipeline time and consequent cost savings have led to an increasing use of autocartography in DMA mapping activities; this trend is confidently predicted to continue. Similarly, requirements for MC&G products to support cruise missile

FIGURE 4-16

FIRST TIME MC&G PAN COVERAGE AND FILM USED FOR KH-9 MISSIONS 1201 - 1212

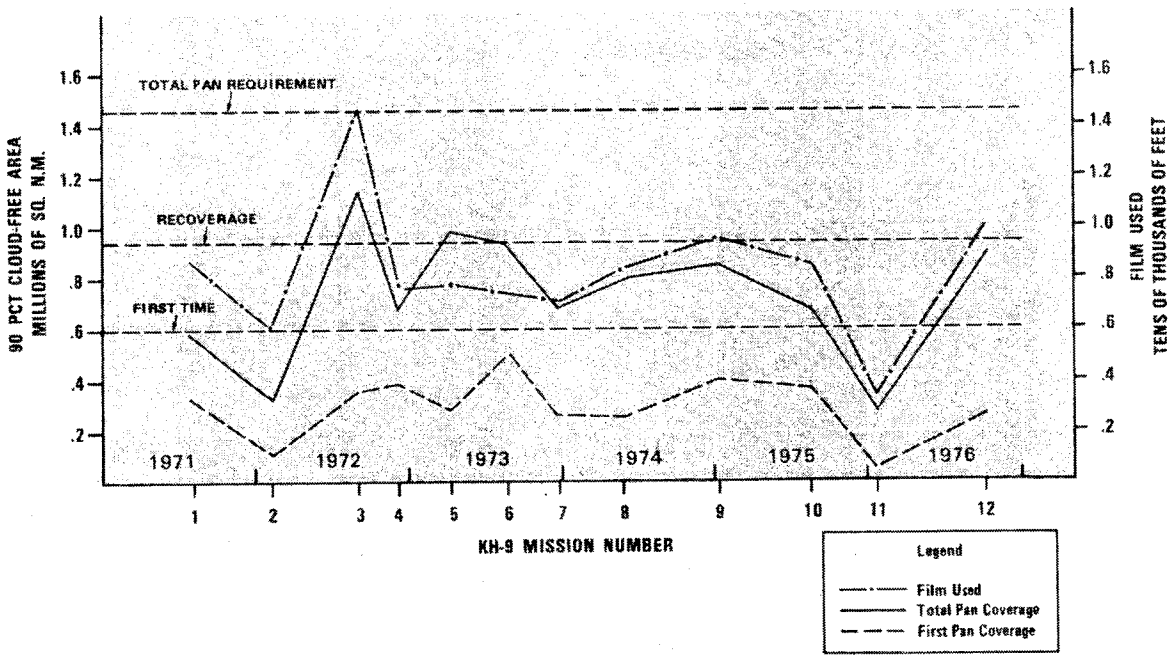

TABLE 4-13

STATUS OF MILITARY AND CIVIL MC&G MCS COVERAGE

(Stereo, 50% Cloud-Free)

	Millions of Square Nautical Miles						
	Sino-Soviet Area	Eurasia	Africa Plus Sinai	North America	South America	Other	Total
USIB-Approved Requirements	10.2	5.2	8.8	5.2[1]	5.4	2.2[2]	37.0
Total Requirements DMA WAG Cell Area	10.4	5.4	8.8	5.7[1]	5.5	4.0	39.8[3]
Collected by End of of Dec 1976 (Msns 1205-1212)[4]	8.5	3.3	2.6	1.0	0.7	0.5	16.6
Balance-Current Requirement	1.9	2.1	6.2	4.7	4.8	3.5	23.2

[1] USIB-approved requirement excludes 1.2 million snm of the U.S.

[2] Australia only.

[3] The USIB-approved requirement of 37.0 million snm converts to 39.4 million snm in the DMA ACRES file, which uses WAG cell areas. Recent mission requirements have totaled 39.8 million snm which include the USGS Antarctica request, 0.4 million snm.

[4] All statistics of coverage are given in terms of 12 x 18 nm WAG cells.

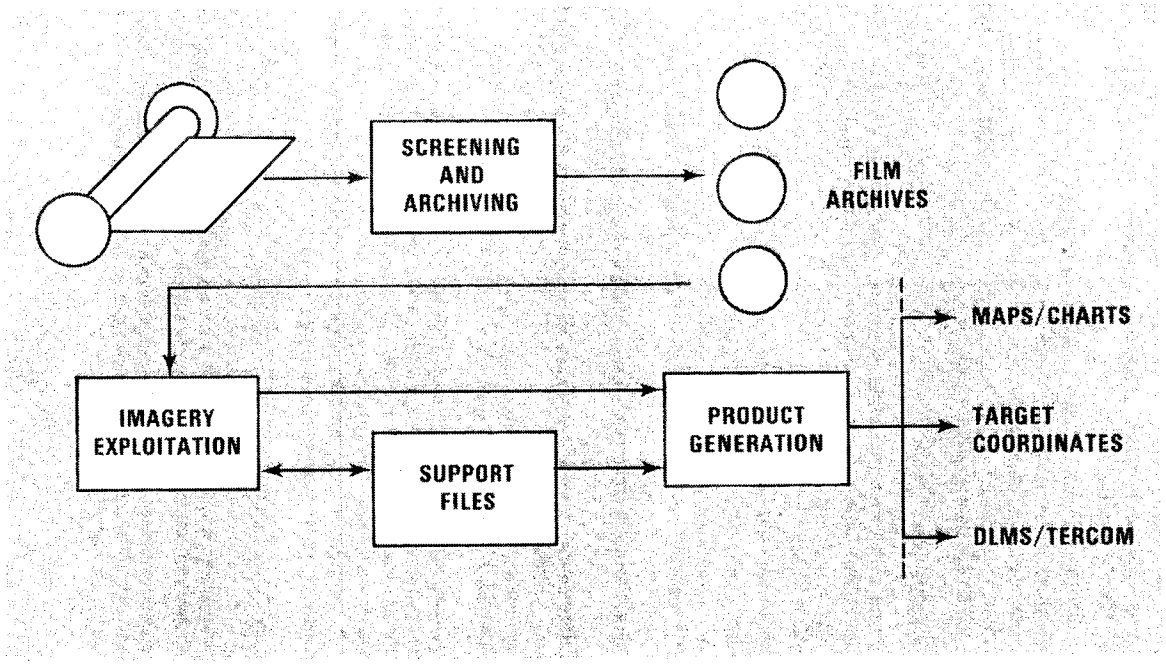

Figure 4-18. DMA MC&G Production Overview

The DMA family of maps and charts has developed over a number of years in a variety of scales and specialized formats designed to support different requirements, specifications and weapon systems. In general, cartographic products depend on the operation supported - land, sea, air, or combination. The intended use of a product also dictates such factors as scale, datum, grid and the nature and extent of features portrayed (planimetry, topography, radar return, intelligence, etc.). Table 4-14 summarizes representative cartographic products produced by DMA.

TABLE 4-14

SUMMARY OF SELECTED DMA CARTOGRAPHIC PRODUCTS

Approximate Map/Chart Scale	Optimum Accuracy (90% Probability)		Reference System Particulars				Representative Projects(s)
	Horizontal (m)	Vertical (m)	Hori. Datum	Vert. Datum	Projection	Military Grid	
1:3,000,000	1500	—	Unsp	MSL	M	—	Naval Warfare Planning Chart
1:2,000,000	1000	150	Unsp	MSL	LCC/PS	GEOREF	Jet Navigation; LORAN and OMEGA Chart
1:1,000,000	500	75	Unsp	MSL	LCC/PS	GEOREF/ ACLANT	Operational Navigation; Bottom Contour Charts
1:600,000	300	45	Unsp	Local	M	UTM/UPS	Coastal Nautical Charts
1:500,000	250	38	Unsp	MSL	LCC/PS	GEOREF	Tactical Pilotage Charts
1:250,000	127	25	Pref	MSL	TM	UTM/UPS	Joint Operations Graphics
1:200,000	101	25	Pref	MSL	LCC/PS	UTM/UPS	Air Target Charts
1:100,000	50	15	Pref	MSL	TM	UTM/UPS	Topographical Line Maps
1:75,000	38	13	Local	Local	M	UTM/UPS	Harbor and Approach Charts
1:50,000	25	10	Local	MSL	TM	UTM/UPS	Large Scale Topo Line Maps and Combat Charts
1:25,000	13	3	Local	MSL	TM	UTM/UPS	Large Scale Topo Line Maps

Unsp - Unspecified
Pref - Preferred
MSL - Mean Sea Level
M - Mercator
LCC - Lambert Conformal Conic
PS - Polar Stereographic
TM - Transverse Mercator
GEOREF - World Geographic Reference System
ACLANT - Allied Command Atlantic
UTM - Universal Transverse Mercator
UPS - Universal Polar Stereographic

The scale of a map or chart depends on its intended purpose. A measure on the graphic represents an increasingly greater distance on the ground as the scale decreases. As shown in Table 4-14, large scale maps are applicable for ground and sea operations. The scale determines the amount and generalization of detail portrayed and limits the potential accuracy of horizontal and vertical information.

The accuracy of a cartographic product depends on the basic source material and the compilation/reproduction processes. The optimum horizontal accuracy for a cartographic product (Class A) is expressed in the meter equivalence of 0.5 millimeters at map scale (90% probability), and the vertical accuracy at one-half the contour interval (90% probability). The combination of scale and accuracy can subsequently affect the significance of the horizontal and vertical datum of the graphic.

The work force composition of the three production centers is shown in Table 4-17.

MC&G technology is extremely complex and requires the use of very precise and highly sophisticated equipment. Many processes require the application of automated digital and analytical plotting equipment unique to mapping. Equipment used in support of DMA's primary mission includes:

Stereocomparators for photogrammetric derivation of positional data;
Analytical stereoplotters for compilation of graphic and digital data;
Automated cartographic systems;
Scientific computers for geodetic, photogrammetric, and cartographic computations;
Lithographic reproduction equipment; and Photographic reproduction equipment.

TABLE 4-17

PRODUCTION CENTERS WORK FORCE COMPOSITION

SKILLS	COUNT
Professional/Scientific:	[redacted]
Cartographers	
Geodesists	
Mathematicians	
Aeronautical Information Specialists	
Physical Scientists	
Other	
Wage Board	
Other	

The total investment for equipment to exploit the panoramic and frame imagery is over 71 million dollars (Table 4-18). This investment has been made to insure that DMA could

TABLE 4-18

MAPPING, CHARTING AND GEODETIC EQUIPMENT INVENTORY DATA APRIL 1977

(MILLIONS OF DOLLARS)

CATEGORY	DMAAC	DMAHC	DMATC	TOTAL
Photogrammetic	[redacted]			
Photographic				
Cartographic				
Geodetic				
Lithographic				
Automatic Data Processing				
TOTAL				