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THE COORDINATION OF PROCUREMENT

16 May 1946

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Students

THE INDUSTRIAL COLLEGE OF THE ARMED FORCES

Washington, D. C.

THE COORDINATION OF PROCUREMENT

May 16, 1946

CAPTAIN HENNING:

Gentlemen, General Rawlings, from the Aircraft Scheduling Unit, Wright Field, is here to talk to us this morning primarily about the operations of the Aircraft Scheduling Unit during the war. The Aircraft Scheduling Unit has been touched upon by some speakers that we have had heretofore, but no one has ever comprehensively reviewed what that very important organization did during the war. I think it will be of the utmost benefit to the students to have this organization described and how it operates.

General Rawlings graduated from Hamline University in 1927. He is a graduate of the Air Corps Primary Flying School and the Advanced Flying School and the Observation Course. He reported to Wright Field in 1935 and spent two years there as Chief, Administration Branch, Field Service Division. After two years at Harvard University he returned to Wright Field as Assistant Budget Officer and subsequently was made Head of the Resources Control Section. During World War II General Rawlings functioned as Head of the Aircraft Scheduling Unit, working directly with WPB, and is largely responsible for the tremendous expansion of the aircraft industry during the war. At present he is Chief of the Procurement Division T/4, Air Materiel Command, Wright Field. His subject is the Coordination of Procurement.

GENERAL RAWLINGS:

Captain Henning, Colonel Brown, and students of the first Industrial College of the Armed Forces: It is certainly a pleasure and a privilege to be here with you this morning and to try to give you a little background of the aircraft production program as we went through it during the past war.

It is my purpose to review this production task which we have gone through, in two ways: first, to give you the organization that was used; and, secondly, to give you a general review of operations. My only purpose in doing that is to lay the background from which we can draw some conclusions that, it seems to me, should be beneficial to the armed forces in preparing for another emergency.

I am going to talk from the level of the Aircraft Scheduling Unit in my discussion because that was where I operated. I will try briefly to show you how it fit into the over-all military production organization. I want to pardon any thought that we are dwelling too much on the Aircraft Scheduling Unit, because it is not with that in mind that I am doing it.

THE AIRCRAFT SCHEDULING UNIT

I will discuss the role of ASU in World War II's joint Army-Navy-Allied Nations-Commercial aircraft production program--in computing all materials-components-equipment-tools required, in encouraging full utilization of all items; in relieving or preventing production bottlenecks caused by critical shortages; in guiding the production and distribution of critical items to satisfy joint tactical needs; and in discharging certain responsibilities delegated by the War Production Board.

In these activities, ASU relied on the resourcefulness of American industry--the peacetime aircraft manufacturers and the wartime volunteers, the automotive industry, the equipment builders, thousands of big and little factories and shops. ASU followed the policy of indicating objectives and limitations, and depended on industry to determine how results could be best accomplished. Problems were approached on an industry-wide basis wherever possible. Army and Navy personnel assigned to represent ASU worked cooperatively as single operating units, without special favor to the individual services. Success was due largely to the fact that aircraft personnel handled all aircraft problems. (Commenting on the accomplishments of ASU and its parent organizations in Washington--the Aircraft Production Board and the Aircraft Resources Control Office--Chairman J. A. Krug of the War Production Board said that "the APB-ARCO-ASU organization, in the central direction of the aircraft production program, has been one of the finest and most successful examples of coordinated federal activity developed in this war. Ltr. to Brig Gen E. W. Rawlings, Administrator, ASU 5 September 1945.

I will describe some of the general experiences of industry and ASU in dealing with problems concerning aluminum, steel, copper, inconel; cadmium, monel-----actuating cylinders, armament, bearings, electrical accessories, engines, fittings, hardware, instruments, oleo struts, propellers, pumps, rubber tires, valves.....tools....and many other items vital to the production of aircraft.

THE RACE FOR PRODUCTION RESOURCES

Any attempt to chronicle the contribution made by ASU to World War II's gigantic aircraft production program must be prefaced by a cursory review of the events which led to the establishment of such an organization.

In 1937 it became apparent that the European democracies had lost the race for military production, that Germany would have an overbearing advantage of weapons unless the European production front was broadened. So, France began buying war planes in the United States in 1937, followed by Great Britain in 1938. At the outbreak of war in 1939, French and British war plane orders increased. By 1940, these countries had more military planes on order with American producers than the United States Army and Navy. In May, 1940, shortly after the British evacuation of Dunkerque, President Roosevelt issued his famous challenge to the resourcefulness of American industry--asked for the production of

50,000 military planes per year. At that time, the industry was geared to produce only 2,000-3,000 planes annually. (American military aircraft production reached its peak in 1944------96,369 planes.)

The race for production resources was on. Confusion reigned. Each aircraft manufacturer was justifiably anxious to obtain his total needs of facilities, tools, manpower, and materials to meet war-swollen committments. Complications resulted from conflicts between the needs of the Army Air Forces (AAF), Navy Bureau of Aeronautics (BuAer), Allied Nations, and essential commercial aviation. There was urgent need of an organization, with representation for all, to coordinate production schedules and the flow of materials-components-equipment-tools. Each manufacturer had to receive what was needed to meet his schedule, yet no manufacturer could be permitted to stockpile at the expense of others. The Joint Army-Navy-British Purchasing Committee, after a study of the proposed aircraft production schedules prepared by the Committee for National Defense (Mr. W. S. Knudsen, Chairman), agreed with the necessity for such an organization.

On 22 April 1941, the Secretary of War--with the approval of the Secretary of the Navy, the Director General and Associate Director of the Office of Production Management (later the War Production Board-WPB), and with the concurrence of the British Supply Council----created the Joint Aircraft Committee (JAC), composed of two representatives from AAF, two from BuAer, two from the office of Production Management (OPM), and two from the British Air Commission. This Committee was empowered to schedule the delivery of all aircraft. Simultaneously, ASU was created to act "as a central clearing agency for all the equipment and materials necessary to maintain the JAC directive schedules." (WD Directive, 22 April 1941, Appendix 11.) ASU was the point of contact between government war production agencies and the aircraft industry.

ORGANIZATION OF ASU

ASU was a policy and supervisory organization, composed of an AAF, BuAer, and British member--- with an Administrator (AAF Member), Assistant to the Administrator, and a Recorder. (Membership of ASU at the time of dissolution: Brig. Gen. E. W. Rawlings, USA, Administrator and AAF Member; Capt. J. . Weldon, USNR, BuAer Member; and Col. W. Sturmy Cave, British Member. Past membership: For the AAF, Maj. J. F. Early (now Col.), Col. P. Schneeberger, and Col. E. M. Powers (now Maj. Gen.); for BuAer, Comdr. B. J. Connell, Capt. D. Royce (now Rear Admiral), Capt. L. D. Webb, and Capt. C. H. Gillillian. Col. Cave represented the British throughout. WPB was also represented until 1942). Its functions were carried out under delegated authority by AAF personnel at Wright Field, Ohio, in conjunction with attached BuAer officers. AAF and BuAer production officers in the Districts, Regions, and Plants also performed ASU functions. Operating personnel numbered almost three thousand at the peak. (100 Navy Officers).

Although the chain of command under which ASU operated underwent changes, there was no departure from its original functions and responsibilities. Created to act under the authority of the Aircraft Production Section, Office of Production Management (WPB), ASU on 9 December 1942 became a part of the newly-created Aircraft Production Board (APB). On 19 February 1943, the Aircraft Resources Control Office (ARCO) was created; henceforth, ASU acted under the authority of APB through ARCO. (Original members of APB were C. E. Wilson, WPB's Production Vice Chairman; Lt. Gen. William S. Knudsen, War Dept; Maj. Gen. O. P. Echols AAF; Rear Admiral Ralph Davidson, BuAer, First Director of ARCO was T. P. Wright, now Civil Aeronautics Administrator. See APB-ARCO-ASU Chart, Appendix IV).

Credit for ASU's accomplishments belongs jointly to industry and AAF-BuAer personnel. Officers, enlisted personnel, and civilians in the twenty odd ASU operating branches and in the District offices at New York, Detroit, Chicago, Wichita, Los Angeles, and Atlanta did an outstanding job for the Services. (ASU operating branches: Basic Data, Special Studies, Component Records, Procurement Records, CMP, Aluminum and Magnesium, Steel, Non-Ferrous Metals, Non-Metallic Materials, Redistribution, Tools, Armament, Bearings, Electrical, Hardware, Instruments, Landing Gears, Oleo Struts, Power Plant, Propellers, Pumps-Valves-Fittings, Rubber, and Miscellaneous. These Branches operated at different times under the Production Survey, Industrial Planning, Production Resources, Production Control, Resources Control, Aeronautical Equipment, and Industrial Facilities Sections. See Resources Control Section chart, Appendix V.)

INDUSTRY COOPERATION

A basic policy of ASU was to cooperate with and utilize industry to the utmost. The industry formed Aircraft War Production Councils early in the war, member aircraft companies pooling their resources and "know how" for the benefit of the overall program. These Councils, acting as clearing houses, were of invaluable assistance. (The Councils: National Aircraft War Production Council, Washington, D.C.; Aircraft War Production Council, Los Angeles, California; Aircraft War Production Council (East Coast), New York, N.Y.; and the Central Aircraft Council (Automotive Council for War Production), Detroit, Michigan.) Industry meetings were sponsored by ASU to provide industry-wide understanding of critical problems to aid their speedy solution. (See Appendix III, Index of minutes of ASU "Meeting of Airframe Representatives and Contributing Subcontractors" attended by 400 odd people at Dayton, 4--5 August 1941. Similar meetings were held on many occasions, the last 17 January 1945 regarding the critical situation existing in aluminum following the German "bulge" of late 1944). Industry Advisory Committees were formed among suppliers of common items to study the causes of critical shortages and recommend actions necessary for relief. (Industry Advisory Committees covered these components: (1) fittings and valves, (2) hydraulic actuating cylinders, (3) hydraulic pumps, (4) fuel and vacuum pumps,

(5) spark plugs, (6) starters, (7) magnetos, (8) generators, (9) carburetors, (10) hydraulic hose assemblies, (11) winterization hose, (12) packing rings, (13) oleo struts, etc.). ASU encouraged industry cooperation by avoiding the issuance of regulations of a too detailed nature, limiting report forms to the practical needs of current situations, and distributing critical information as widely as possible by personal contact; by telephone, letters, wires, charts, booklets, and information bulletins. (See ASU Information Bulletin and Flow Chart, Appendices VI and VII.). ASU focused attention on the few hundred plants which actually consumed 80-90% of all materials-components-equipment-tools and thereby was able to keep from being "snowed under" by a mass of detail.

AIRCRAFT PRODUCTION SCHEDULES

ASU's function was "to maintain the directive (production) schedules" issued by JAC, based on tactical needs. JAC schedules for airframes and engines were the basis for all other production scheduling. Although these schedules were officially released in the name of ASU, it being the point of contact with the industry, actually ASU had nothing to do with their development.

However, in the spring and summer of 1943, ASU did make a study of the capacity of industry to produce the scheduled planes with the then available materials and other resources, which resulted in the first " working" schedule (known as "W-1"). Prior to "W-1, the desired or " target" schedules were so much higher than available resources would produce that overall production sometimes suffered. Planes which could have been completed were deprived of critical items, while these same items were incorporated in other planes which could not be completed until much later. An important mission of ASU was to avoid this wherever possible, diverting critical items from planes which could not "fly away" promptly to those which could.

Necessary battle changes caused constant fluctuation, increases and decreases, in the schedules for the production of various plane models. These changes presented serious problems in the control of production materials, requiring the constant attention of ASU and industry.

AIRCRAFT PREFERENCE GROUPS

The relative urgency of the various authorized schedules was determined by the Aircraft Preference List issued by JAC. This list rated the models of airplanes according to their tactical urgency: GROUP I, experimental models and certain very high priority programs; GROUP II, the more urgent planes; other models were divided among lower preference groups according to urgency. The Preference List was used as a last resort, when the conflicting interests of authorized production schedules could not otherwise be balanced.

In addition to these thousands of individual shortages "cured", far more were relieved or avoided by preventive means such as Requirements Studies, Controlled Materials Plan, Production-Distribution Guidance, and Industry Material Controls.

REQUIREMENTS

Total requirements of materials-components-equipment necessary to build the authorized aircraft schedules were developed by ASU, to assure an orderly flow of these items to industry.

For intelligent planning, the items needed for the expanding aircraft program had to be determined, as well as the items required for each type of plane. It was essential to know what was needed, when, where, and in what quantity, sufficiently far in advance to assure capacity to satisfy the needs. It was necessary to know what suppliers must be expanded further, at what time, and to what degree. Basic information was obtained through bills of materials, surveys, and special studies. Accuracy of this basic data was absolutely essential to sound requirements.

Bills of Materials from manufacturers contained information which made possible short-notice, machine, calculation of overall requirements. (A Bill of Materials is a quantitative and descriptive listing of all raw and semi-fabricated materials (excepting processing materilas), and all of the Government Furnished Equipment and purchased parts required by the manufacturer and his subcontractors to produce one completed end product--an airplane, engine, or carburetor, etc., Including name or identity of each item, form, size and description, specifications, unit of measure, quantity, flow time.) A Bill of Materials including alloy steel, for example, indicated quantities per plane, specifications, and such variables as heat treatment, whether hot or cold rolled, whether normalized and the like. Almost any type of information, such as the exact number of fittings, gun mounts, or instruments, necessary for any type of plane, or for all planes, could be computed. Requirements were recalculated as important changes were made. ASU collected over 9,100 Bills of Materials covering 6,000-7,000 items. Additional Data were maintained in a complete library of Army-Navy Specifications, Technical Orders, Manufacturers' handbooks and catalogs.

Certain items demanded specialized research--"special" studies, of which ASU made 260 on components and equipment items, and 224 on materials. (See list of "Special Requirements Studies", Appendices VIII, IX, X and XI).

Aircraft Hydraulic Oil was the subject of a "special" study. This oil had to withstand temperatures ranging from 70° F. below zero to 140° above. The development of requirements entailed seeking information from many sources. (Sources of information for study on Aircraft Hydraulic Oil: Bills of Materials, specifications, contracts, purchase orders,

Technical Orders, engineering drawings, and aircraft manufacturers. Additional information was sought from the Navy Bureau of Aeronautics, Bureau of Supply and Accounts, Winterization Office, many units of ATSC's Engineering Division (particularly Armament, Instruments, Aircraft Laboratory, Equipment Laboratory, Materials Laboratory), Air Service Supply and Maintenance groups, Modification Centers, and from United Nations Liaison Office, Land-Lease Administration, War Production Board, Aircraft Resources Control Office, and the research group working on oil at Pennsylvania State University under directive of the National Defense Research Committee.) Requirements were covered in twelve separate projects from 1942 to 1945, including overall needs for petroleum base and castor base oils, unit requirements per airplane for all models showing uses in struts, brakes, airframes, superchargers, auto-pilots, oil gage lines, armament, propellers, beaching gear, jettison latches and cylinders. Studies were also made of the hydraulic oil components, such as petroleum base oil and poly-iso butylene, of acryloid polymer HF, and high-molecular-weight alcohols.

Another "special" study covered friction-type bearings and bushings. Due to a large number of critical shortages, engine manufacturers urged an expansion of bearing fabricating capacities. ASU made a 183-page study, covering bearing requirements for each engine authorized to be produced. The report gave engine manufacturers, and their bearings vendors, the first real knowledge of overall requirements. At a meeting of engine manufacturers at Wright Field, the findings of the study were revealed and manufacturers agreed that no expansion of the bearings industry was needed, that critical shortages could be eliminated by better scheduling.

In obtaining basic information as to gross requirements, it was necessary at times to consider existing inventories and work in process, and whether the rate of deliveries from suppliers permitted efficient production schedules. For example, the Aeronautical Equipment Record (Black Book) compared the requirements and availability of Government Furnished Equipment needed for the production and maintenance of aircraft. Information used in compiling this Record was: (a) quantity of items required for authorized aircraft schedules adjusted monthly for shop completions, modifications, spares, and miscellaneous; (b) "to date" receipts by aircraft manufacturers and Government ware house inventories; (c) estimated future monthly production by GFE suppliers. The Record served as a basis for determining the rate and amount of excesses and deficiencies in production and procurement; for the adjustment of over and under production; for the initiation or cancellation of procurement. Such a device was absolutely essential to proper utilization of components and component producing capacity.

ASU experience indicated that policies, procedures, and paperwork for the development of requirements must be given top priority in any operation concerning materials-components-equipment-tools; that maximum coordination with the practical operations of industry must be

accomplished to assure reasonable accuracy in requirements.

CONTROLLED MATERIALS PLAN (CMP)

In the fall of 1942, the mass of shortages created by the constantly expanding war program made it obvious that the production of war weapons in practical balance with war needs required an overall system for controlling the purchase and use of production materials in addition to the controls on many individual items.

The Controlled Materials Plan(CMP) was developed by WPB. Under CMP, purchase and use of the critical and large consumption materials--aluminum, steel, and copper-was guided; other materials were expected to become less critical as a by-product of CMP.

Basically, CMP was simple. The WPB selected the government offices concerned with the production of war products and essential civilian goods. These were called "Claimant Agencies" and included the War Department, Navy Department, Office of Civilian Supply, etc.--fourteen (14) in all. The Claimant Agency for the AAF and BuAer was ARCO, represented by ASU. Between them, these Claimant Agencies represented all industries using aluminum, steel, and copper, except in the case of an industry which furnished the same product for several Claimant Agencies--in which case, the industry, as to that product, was represented by an Industry Division of WPB or in a few cases by ASU.

The Claimant Agencies and Industry Divisions determined the controlled materials required by their industries, and WPB's Requirements Committee allotted the materials available. Each Claimant Agency and Industry Division re-allotted the materials to its "Prime Consumers". Secondary consumers continued re-allotting until the controlled materials had filtered down through the production chain.

In the early days of CMP (and throughout its life on some items) there were insufficient quantities of these critical materials available to meet all the requirements of the aircraft program; allotments to aircraft manufacturers were frequently less than amounts requested. This situation required careful planning and constant vigilance on the part of ASU and industry. Quantities allotted were determined by first screening the individual requests of manufacturers down to their minimum needs and then applying an arbitrary cut based on the preference grouping of the planes involved. The screening consisted of (1) comparison with the manufacturer's Bill of Materials, (2) comparison with requests and allotments for preceding periods (and other inventory and consumption records), (3) comparison with amounts stated to be put into production, and (4) discussions with manufacturers' personnel. Preference group ratings were applied to all requests, but cuts were larger for lower group planes. (See "Instructions for Making Fourth Quarter CMP Allotments" and "Procedure for Screening," Appendices XII and XIII).

ASU's CMP personnel processed more than 61, 471 applications for allotments from 757 prime manufacturers and 1365 component suppliers, involving more than three and a half billion pounds of aluminum, seven billion pounds of steel, and a half billion pounds of copper and alloys.

CMP's real contribution was its encouragement of the full use of all available materials to the best current advantage. In the Third Quarter, 1943, actual allotments to the aircraft industry were substantially less than requests, and yet the industry was able to meet schedules because of the steadily improving utilization of materials.

PRODUCTION AND DISTRIBUTION GUIDANCE

Many materials- components- equipment- tools were in such short supply at times that special action was necessary to determine what should be produced and to whom and how it should be distributed. (Examples of items which needed special attention for at least a limited time were: Materials: Aluminum (Forgings, Pressings, Upsettings, Impact Extrusions, Castings); Cadmium; Copper Alloy Strip, Rod, Tubing, and Bar; Cotton Duck and Webbing; Acryloid HF Polymer; Gasoline; Inconel Mesh; Lumber (Aircraft) Magnesium (Sand, Permanent Mold, and Die Castings, Sheet, Extrusions, Forgings); Methyl Methyacrylate; Monel; Nickel; Nylon; Steel Forgings (Aircraft); Steel Tubing (Aircraft); Tungsten. Components; Anti-Friction Bearings; Anti-Icing Equipment, Actuators, Automatic Pilots, Bomb Arming Controls, Carburetors, Camera Lens (Gun Type), Circuit Breakers (Electrical Compressors, Distributor Heads for Allison Engines, Engine Mounts, Filters, Fittings, Fuel Indicators and Transmitters, Fuel Injection Systems, Fuel Pumps, Gyro Flight Instruments, Hardware, Hydraulic Accumulators, Hydraulic Pumps, Hose, Ignition Systems, Intercoolers, Lamps (Instruments), Landing Gear, Retractors, Magnetos, Motors (Fractional HP), Motor Protectors, Oil Coolers, Oleo Struts, Regulators (Supercharger and Water), Rubber (Tire Casings, Tubes), Shafts (Flexible), Sleeve Bearings, Switches, (Electrical), Turrets, Vacuum Pumps, Valves, Wheels and Brakes.). Some items, of which the aircraft industry was chief consumer, could be controlled by corrective action of ASU. (From the total poundages produced, aircraft consumed of aluminum 70-odd%; carbon steel 1%, alloy steel 10-15%, electric furnace alloys 40-50%, steel forgings 20-25%; commercial lumber 5%; cotton duck 25-odd%; methyl methacrylate sheet 95%; nylon for several months 100%. These estimates varied from time to time.) Others of which the aircraft industry was a small, but vital consumer required close coordination with WPB and other agencies to assure full awareness of aircraft needs, and prompt action on shortages. (The " Special Aluminum and Magnesium Committee", arranged in the office of Under Secretary of War Patterson, reported on 17 March 1942 that : (a) WPB Aluminum-Magnesium Division would assemble the minimum "beaten down" requirements of aluminum, determine capacity for producing each form, and notify ASU the quantities available for aircraft; (b) ASU would guide distribution to the aircraft industry; (c) WPB would take the lead in

coordinating mill fabrication with manufacturer usage of "standard" items such as sheet, tubing, rivets, wire, rod, bar, and ASU would lead as to "special items" such as forgings and pressings; (d) WPB would handle scrap, calling on ASU where necessary.). Methods of guiding production and distribution, used by all ASU branches are illustrated in the following paragraphs.

INFORMATION ON SOURCES

Sources from which critical items could be obtained were made known to industry through catalogs on aluminum extrusion dies and users, commutator copper bar, and other items. All branches maintained close touch with suppliers and therefore were familiar with open spots in production schedules.

SPECIFICATIONS, STANDARDIZATION, AND SUBSTITUTION

Experience or investigation often showed an "easier to get" item would serve practical production needs as well as the critical item. For example, on aluminum extrusions it was necessary to resort to substitution of rolled form sections; the use of 14S aluminum alloy instead of 24S; the acceptance of random lengths; the fabrication of minimum runs; the relaxation of tolerances; the use of existing and common dies; the standardization of shapes. On other aluminum commodities-tubing, wire, rod, bar, sheet, strip a "non-standard" program was begun in 1942, requiring ASU approval before any special sizes or shapes could be fabricated.

The National Emergency (N.E.) Steel program resulted in aircraft taking 40-50 percent of its needs in the desirable "triple alloy" grades. (See ASU Directive No. 38-4 "Substitution of Triple Alloy Aircraft Steels for Single and Double Alloy Grades".). AN Standard Tubing, Pipe, and Hose Fittings were required. (See ASU Directive No. 39 "Aluminum Alloy Tubing Sizes").

Other substitutions were common: Phosphor bronze for beryllium copper rod, tubing for rod in axial drilled screw machine parts; rough turned for highly finished surfaces; and so on through every material and component.

On the other hand, experience has proved that substitution of less desirable materials should only be made after exhaustive study of the production possibilities of the desired materials. For example, at one time during the program aluminum was so short that a wood substitution program was invoked. However, before design, engineering, production equipment, etc. could be worked out, aluminum was available. Also wood, the item being substituted, subsequently became critically short. The net result was confusion and delay in aircraft production.

WAREHOUSING

Certain special items of aircraft quality were order by manufacturers in relatively small lots. However, minimum economical production runs in suppliers' plants were too large to permit filling such small orders, nor could emergency small orders be filled. Consequently, ASU (in cooperation with WPB) sponsored a program consisting of 13 warehouses, strategically located, which stocked aircraft steels to prevent critical shortages and permit small procurements; other warehouses stocked hardware; tube, pipe, and hose fittings; valves, etc. (See ASU Directive No. 8"Assembling of Initial Warehouse Stocks of Aircraft Tube, Pipe, and Hose Fittings, Parker Type Valves".) The steel warehouses alone filled 200,000 small orders. Warehouses for this program were selected by the industry and were normally in the warehouse business and therefore possessed the "know how" of this kind of operation.

REDISTRIBUTION OF SURPLUSES

Items surplus to a plant were redistributed to other plants to fill critical shortages. ASU encouraged the redistribution of surpluses among the aircraft plants as "normal" business. In addition, in the fall of 1942, voluntary registers were established in the District offices to list surpluses of standard aluminum, steel, and copper available in aircraft plants. This plan was supplemented by a regular ASU form to expedite transfers. In 1943, the registers were centralized at Wright Field, and other standard items were added- switches, bearings, motors, etc. In view of impending terminations in 1944, the emphasis changed from the relief of critical shortages to general redistribution. The ASU registers were abolished, and a Memorandum of Understanding was executed 3 May 1944 between ASU, AAF, BuAer, and Metals Reserve Company (RFC), under which aluminum, steel, copper, and other standard items were reported to an agent of Metals Reserve Company (RFC) for redistribution through commercial warehouses. These reports were screened for shortages by ASU. This arrangement was eliminated 15 May 1945 to place all plant clearances under termination regulations.

DIRECTIVES AND AAA PREFERENCE RATINGS

Sometimes ASU or WPB issued directives or AAA emergency preference ratings as a general control; for example, on fibreglas for thermal and accoustical insulation, WPB issued AAA ratings each month to cover aircraft orders recommended by ASU.

PRODUCTION GUIDANCE

ASU informed short item suppliers what to produce and to whom to ship without binding the supplier to do so. ASU looked over the supplier's order board and advised which orders were most important, based on J&C preference groupings; or suggested a complete rescheduling.

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In many cases the JAC authorized schedules were given to suppliers regularly for use in planning and scheduling. Where an item was especially critical, continuous assistance was given on facilities, manpower, engineering, specifications, materials, scheduling, and other problems preventing prompt deliveries. Frequently, personnel was placed in plants to assure aggressive action.

A number of meetings (similar to those of Industry Advisory Committees) were held at Wright Field in which the bearings industry was informed of production problems and future schedules. By keeping all manufacturers closely in touch with schedule changes on aircraft engines, it was possible to forecast requirements and utilize manpower and machine tools in the most efficient manner.

PRODUCTION SCHEDULING

Balanced distribution of items in short supply was often attained by rescheduling the planned shipments of suppliers. Estimated requirements plus supporting data were obtained from manufacturers. Suppliers capacity was then scheduled to parallel manufacturers' authorized production schedules, flow times, inventories, and urgencies. (See ASU Directive No. 12 " Authority for Scheduling and Allocation", Appendix XVI). Information was procured in a simple and direct way- visits, telephone, wire, mail or forms.

Critical shortages of steel were avoided by "put and take" rescheduling of mill shipments. Upon advice from ASU, WPB directed the removal of a specified tonnage of steel from mill schedules and the substitution of more critical tonnage. Normally the tonnage thus removed did not hamper other aircraft production. " Put and take" was made possible by alloy steel mills reporting monthly "melt schedules" to WPB, which led to WPB's directing certain mills to leave openings in "melt schedules" for critical aircraft orders. Some large manufacturers voluntarily informed ASU of their requirements and orders each month; in one case, by eliminating steel for which the manufacturer could wait and substituting steel urgently needed, receipts of his critical requirements rose from 30% to 95% in four months. ASU was preparing to expand this voluntary arrangement to the 50 manufacturers consuming 8% of all aircraft steel, however, when CMP was adopted the plan was dropped.

ASU worked directly with steel forge shops in adjusting total forge schedules within the capacities alloted to aircraft. These shops submitted a list of all orders received so that ASU could work with the manufacturers to effect a reduction of orders to minimum requirements and relative urgency.

Machine tools for aircraft were scheduled through the WPB Tools division. ASU representatives visited aircraft and then tool suppliers' plants, alone or with a WPB representative, to effect the best scheduling. Order boards were frozen for 90 days, semi-frozen for the subsequent 90

days.

Electrical items illustrate components which were under the cognizance of WPB, but of great concern to the aircraft industry. Considerable trouble was occasioned by these items being so far down the production and contractual chain that suppliers received notice of engineering, modification and like changes only at the last minute. Most of the Electrical Branch's program and scheduling work was in conjuction with WPB, except for production guidance which was extensive.

ALLOCATION

The full use of facilities frequently required the allocation of suppliers' capacities to assure adequate distribution. The basic operations were similar to "production scheduling", except more strict and detailed. (The screening of requirements was comparable to CWP procedure. See Appendices XII and XIII).

The scarcity of dies and hammers for the fabrication of aluminum forgings forced the allocation of this commodity by individual pieces until December 1944. This program was one of the most successfu.. Manufacturers listed the forgings required and when needed on a simple ASU form. ASU then scheduled the 57 forge shops fabricating aircraft forgings on the basis of capacities allocated to ASU by WPB. On 1 July 1943, WPB's Forging Section, responsible for capacities, moved to Wright Field for closer coordination with ASU. The Navy was especially concerned with forgings for heavy structural members of carrier based dive bombers.

Aircraft steel tubing, even more specialized than other aircraft steels, was allocated from 20 mills as early as January 1942, as a means of bringing the non-aircraft tubing producers into the aircraft program allocation continued throughout the war.

Engines and propellers were tailor-made to fit each plane model, and production was allocated to match latest JAC airplane programs. Allocation reports showed total requirements for each plane model, each contract scheduled to completion, and the manufacturer's shop schedule or estimate of production rate, to indicate whether schedules would be met. At times, schedules were decelerated due to a lag in production on new or radically changed plane wchedules, or completion of engines was delayed to permit production of urgently needed spare parts. Engine allocations were issued by ASU, although prepared by the JAC Engine Sub-Committee. Propeller schedules were developed by AAF and BuAer separately-although in close cooperation to eliminate duplication of production or experiment and then incorporated into the ASU propeller "Black Book" at Wright Field.

Oleo struts were allocated even before Pearl Harbor while production was being expanded beyond the two companies then manufacturing struts. Thirty-four companies were finally in the program at its peak in 1944.

Twenty-eight strut models were allocated to these new sources. The allocation reports presented a complete picture of the overall strut situation for the existing suppliers and those being developed. Allocation continued during 1942 because of machine tool shortages. Toward the end of that year, raw materials, especially steel tubing and forgings, became extremely critical, making allocation during 1943 necessary. A drastic cut-back in spares permitted the ending of allocation as of 1 September 1944.

Aircraft hydraulic and instrument hose was allocated by the Rubber Bureau of WPB at monthly meetings in Washington, ASU submitting the claims of hose assembly manufacturers, Supply Division of ATSC, and the Naval Aviation Supply Office. Representatives of the rubber companies attended these meetings and estimated their manufacturing capacity for the ensuing month. Allocations were made accordingly. Through cooperation of the rubber companies, production of certain sizes was concentrated in a single company even through it might be of a size which persented many manufacturing difficulties. Another form of cooperation was lending equipment from one company to another in order to increase overall production.

AAF and BuAer needed a detachable end-fitting which could be removed from unserviceable hose and reused with new hose. Early in 1943, a detachable fitting was selected as AN Standard, but the sole supplier could not produce the total requirements. An Industry Advisory Committee was organized. The Committee's activities led to several other companies accepting licenses to make the fitting. ASU assisted in procuring necessary equipment and machine tools, planning production, and allocating distribution.

SINGLE PROCUREMENT AGENCIES

Lumber and plywood were procured through the Corps of Engineers, with ASU authenticating all aircraft orders. At one time a representative of ASU was stationed at the Central Agency Office in Portland, Oregon. All cotton duck and webbing orders for aircraft were screened through ASU for purchase by the Quartermaster General, Jeffersonville Depot.

MATERIAL CONTROLS IN THE AIRCRAFT INDUSTRY

Aircraft production and material controls, the foundation of all operations as to materials-components-equipment, were more complex than in other mass production industries. (One heavy bomber, of which thousands were built, required the assembly of more than 30,000 separate parts, and more than 465,000 total parts. Each of these parts had to "run the gauntlet" of unusually interdependent designing, engineering, tooling, standards, production control, material control, purchasing, manufacturing, inspection, transportation, and related jobs--all necessary operations).

The problems were multiplied by war created factors. (War created factors which complicated material controls: Constant changes in authorized production schedules; inability to estimate accurately probable progress towards "target" schedules; Engineering changes dictated by battle needs; Lack of time and experienced personnel to improve operations; Need for management and supervisory attention on even more pressing tasks; Lack of experience as to actual requirements resulting in Bill of Materials errors; Unreliable deliveries from suppliers; Minimum runs; inadequate control of subcontractors.) Still very commendable progress was made. (As an example of the continually improved control of inventories, see the War Production Board chart on "Aluminum Sheet Shipments (By Mills), inventories, and Aircraft Consumption" which is typical of most materials and components. Appendix XVIII). Production - Material Control people did their part in maintaining a steady stream of aircraft and spares to every part of the world, and in reducing the waste inherent in war.

From the first, it was recognized that improvements depended on the day-by-day work of industry personnel. To avoid critical shortages and waste, ASU urged industry to improve controls, to keep inventories low, and to place orders early enough so that suppliers could operate efficiently. (ASU Directive No. 41.2 "Contractor Procurement Policies", issued 17 January 1945, summarized the policies followed by ASU since the early years of the war, and was worked out in cooperation with the aircraft industry and Councils, Appendix XVII).

In addition, ASU kept close contact with the CMP inventory Audits accomplished by the Air Technical Service Command in the plants of AAF and BuAer manufacturers. Surveys were commenced in the fall of 1942, as a WPB compliance program, which rapidly evolved into a program for encouraging efficient material control.

CMP analysts- working out of New York, Detroit, Chicago, Wichita, Los Angeles, and Atlanta- visited larger plants every few months and smaller ones less often. Surveys were made of inventory-order records and control operations. The information developed was discussed thoroughly with operating personnel, supervisors, and sometimes management . Each survey was written up in detail and furnished to the manufacturer and local AAF or BuAer office for use in making improvements. (Instructions to Audit Supervisors and Analysts emphasized an informal, frank, and cooperative approach; prompt and practical results; substantial and not trivial problems; the analysts duty to develop sound and full information, verified by plant personnel; non-technical reports; reliance on the company to correct its operations in its own way.) After industry became convinced of the cooperative intentions of the analysts and follow-up officers, a very satisfactory relationship developed and a number of larger companies voluntarily requested surveys of their operations.

A review of the hundreds of surveys of larger plants showed that no two companies did any job exactly alike, and there was no one "best" way judged by results. However, Major decisions by management and supervision which initiated real improvements involved these fundamentals: Coordination between operating departments to assure common objectives and avoid duplications; Policies to support sound programs and fix responsibilities; Procedures and paperwork need to be confined to immediate and practical purposes, and made simple: Operations analysis was a "must" to assure the maximum use of all available "know how", particularly of operating personnel. (See "Scheduling Group Functions," Appendix XIX). Operating problems which continued to be of common concern were: Releases to production; Utilization of actual consumption experience; Economical rescheduling; Minimum quantities; Earlier-than-scheduled receipts; Production rates and inventories of sub-contractors.

CONCLUSION

This report would not be complete without a list of conclusions based on the operating experiences of ASU in World War II. It is believed these conclusions--though not all inclusive--are fundamental and basic facts which must be remembered in the event of another emergency. The next war--if there is one-- will move with such speed that there will be no time to learn "by experience".

One: A single government organization should be the "clearing house for production" between industry and the agencies which require aircraft and related equipment. Its purpose should be to receive information regarding tactical military needs for individual plane models and translate them into practical and reliable production schedules for manufacturers and suppliers, permitting the fast and full utilization of manpower, materials, tools, and facilities. ("Mass production depends on careful planning, on finding the exact rate of flow at which the best work can be done, and on the mechanical efficiency and accuracy with which the plan is put into effect".--William S. Knudsen.

TWO: The basic essentials for such scheduling are information as to the aircraft and equipment needed for tactical purposes and Bills of Materials listing the materials-components- equipment required for their production. The information must be available for the overall aircraft program. Requirements studies, scheduling, and distribution controls are based upon this basic information and will be useful only to the degree that it is correct.

THREE: The "clearing house" must be vested with full responsibility and authority to deal directly with all other agencies, manufacturers, and suppliers, to act on its own initiative.

FOUR: The approach to aircraft production problems should be on a broad basis so that the "clearing house" does not become lost in a mass of details, and miss major opportunities to assure fulfillment of production objectives. Under emergency conditions, a 90 % job done rapidly is better than a 100% job which takes too long. Attention should be focused on the relatively small number of companies responsible for 80-90% of all aircraft production. In World War II these numbered less than a hundred large, and a few hundred medium size companies. Regulations must not be too detailed and must not demand excessive reports.

FIVE: The resourcefulness of industry must be used fully, "self-help" emphasized, and industry put in a position where it can use its production "know how" with a minimum of interference from Government agencies. Industry should be consulted constantly in the development of policies and procedures. Practical and informal cooperation, especially at operating levels, is essential to results.

SIX: Controls over production and distribution should be utilized only where absolutely essential, and eliminated as rapidly as normal manufacturer-supplier relationships appear able to take their place. Early placement of orders plus the scheduling of receipts from suppliers on a low inventory policy will help avoid the need for excessive control. In an emergency, there must be a firm policy of encouraging manufacturers to avoid accumulating too large inventories. Unnecessary buying causes short supply items to become even more critical, and is no advantage on items in abundant supply.

Thanks for listening. I appreciate the opportunity to speak to those who must prepare for future mobilization.

CAPTAIN HENNING:

General, you certainly covered many very important points in industrial mobilization.

There is one thing I would like to point out. In the early days considerable confusion was caused due to the fact that the Aircraft Scheduling Unit, either by design or absence of appreciation, seemed to disregard the existence of the Army and Navy Munitions Board, which was charged, at least theoretically, with the coordination of conflicting requirements between the various arms and services. Later on that was corrected. But, as that chart shows, the Aircraft Scheduling Unit went directly to WPB. There was sort of an interlocking directorate, as I understand. You had some WPB people, I think, out at Dayton.

What are your views in planning for a future emergency as to just what should be that organizational channel so we can be assured at the service level of ironing out these conflicts of requirements before they go up to the controlling civilian agency?

That was subsequently corrected and ASU went through the Army and Navy Munitions Board, particularly on machine tools; and I think it was recognized that they themselves benefitted by that. But I would like to get your views as to the future organization.

GENERAL RAWLINGS:

I didn't happen to be in the organization at its inception, so I can't tell you the exact reason. But I think I have a pretty good idea of it. I think the reason was that we didn't get what we wanted. It was probably to some degree our own fault, in that we didn't have proper representation on the Army and Navy Munitions Board. The aircraft program initially did not have a high enough priority in the over-all program in the opinion of air officers. Therefore we were in conflict with and in competition with all of the other services, and initially between the Air Forces and the Bureau of Aeronautics. It was not until we got the blessing of WPB and set up the Aircraft Production Board and ARCO that they could get any direct action and could get what I suppose an air enthusiast would call proper consideration.

That, of course, is a very touchy point. I wouldn't argue it one way or the other except to say this: You should try to resolve conflicting problems at the lowest possible level in the organization. We found when we finally had this set up made, there were very few problems, as a matter of fact, in the two and a half years that I was there I don't remember a single important one, that ever went up to higher head-quarters, and certainly none that ever went to the Secretary of the Navy and the Secretary of War.

Now, whether the Army and Navy Munitions Board is too high a level in the operation, I am not sure. That may be part of the problem. I think it was probably because we were not properly represented there. However, after the organization had been developed, it worked very satisfactorily.

A STUDENT:

General, why didn't the unit that you were part of make greater use of the production know-how of the industry that was recognized as being expert in the field of production? Maybe I should explain that a little bit.

According to figures that were presented here-- and I think they were fairly accurate--the aircraft industry business index expanded some one hundred times over a stated period, which I don't remember the date of. Some weeks ago the president of Chrysler Corporation told us, as I remember the figure, that their personnel at the peak had expanded something like 25 per cent. That may be off a few per cent one way or the other. Certainly Chrysler was and is recognized as an expert in production.

Now, back in 1940, when the President gave the green light on that 50,000 plane program, certainly the people planning it knew that that was primarily a production problem; and those people who were experts in production, in my opinion, should have been called into the thing to participate as they were best able to; not to expand 25 per cent, while the aircraft people, who didn't know anything about production--and I don't think that is a fair statement--I think they deserve a great deal of credit for research and development, but they don't know as much as the industrial experts do. And yet they expanded several hundred times as much as an organization like Chrysler did.

Now, you have three principal parts to this, as I see it. One is research and development. That is No. 1. No. 2 is production. No. 3 is coordination between 1 and 2. Why couldn't the airframe people stay pretty much in the No. 1 field, coordinate with No. 2, and let the production experts do the bulk of the production work?

GENERAL RAWLINGS:

I think that is a pretty fair question. I don't know all the answers to it, but I will give you some reasons back of it. I would like this to be off the record.

One of the basic reasons probably was that there were so many basic changes in the production of aircraft in keeping them abreast of development that it was a new kind of business even for the production industry. Also it is essential that the people that do the designing help out on production in the early stages.

My guess is that, probably, you must arrive at some compromise half way between the two. I think our industrial plans probably were not as sound as they should have been before the war.

I think this is an important point: What we did was to set up an industrial planning organization, a separate organization, which had a little group of planners, who talked to people in operations and got ideas; but still the hearts of the people that were going to do the real job were not back of the particular program. So the result was that we found our people in operations did not believe in the plans. That is a thing we must be very careful of.

Probably another basic reason is that people generally don't like to get into businesses that they don't know much about. I think we will probably have to arrive at some compromise between using our aircraft people and utilizing the production brains of the so-called mass-production industry. However, that certainly must be tied into our other munitions programs. If we are always going to use the automobile industry to produce planes, we are not going to have anybody to make tanks and other things.

Does that answer your question?

A STUDENT:

I think it does. I think one thing that would further help along that line would be if the people who did the research and development were given a profit commensurate with their contribution.

GENERAL RAWLINGS:

I agree with that.

A STUDENT:

A lot of that was done after the war.

GENERAL RAWLINGS:

Of course, as you know, the procurement laws of the country don't allow for that. There is a profit limitation. If I am correctly informed, the services have agreed on a new procurement bill, which is currently going through the hopper in Congress, which does provide for a higher rate of profit for research activities. But according to statute that is impossible to do now.

CAPTAIN HENNING:

Any further questions? If not, we thank you very much.

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