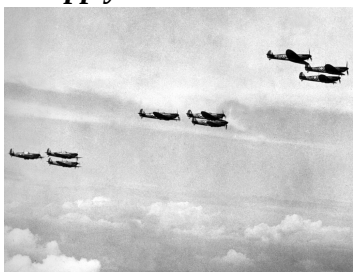
LESSONS FROM HISTORY

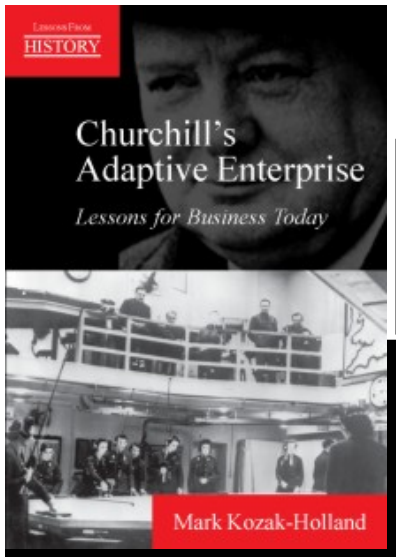
Churchill's Supply Chain

New publication

Project Lessons Learned Beaverbrook's story

Demand Driven Supply Chain





Presentation to xxxx
Xxx xxx, 2007
Mark Kozak-Holland

"Lessons From the Past that Assist the Projects of Today to Shape the World of Tomorrow"

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LESSONS FROM HISTORY

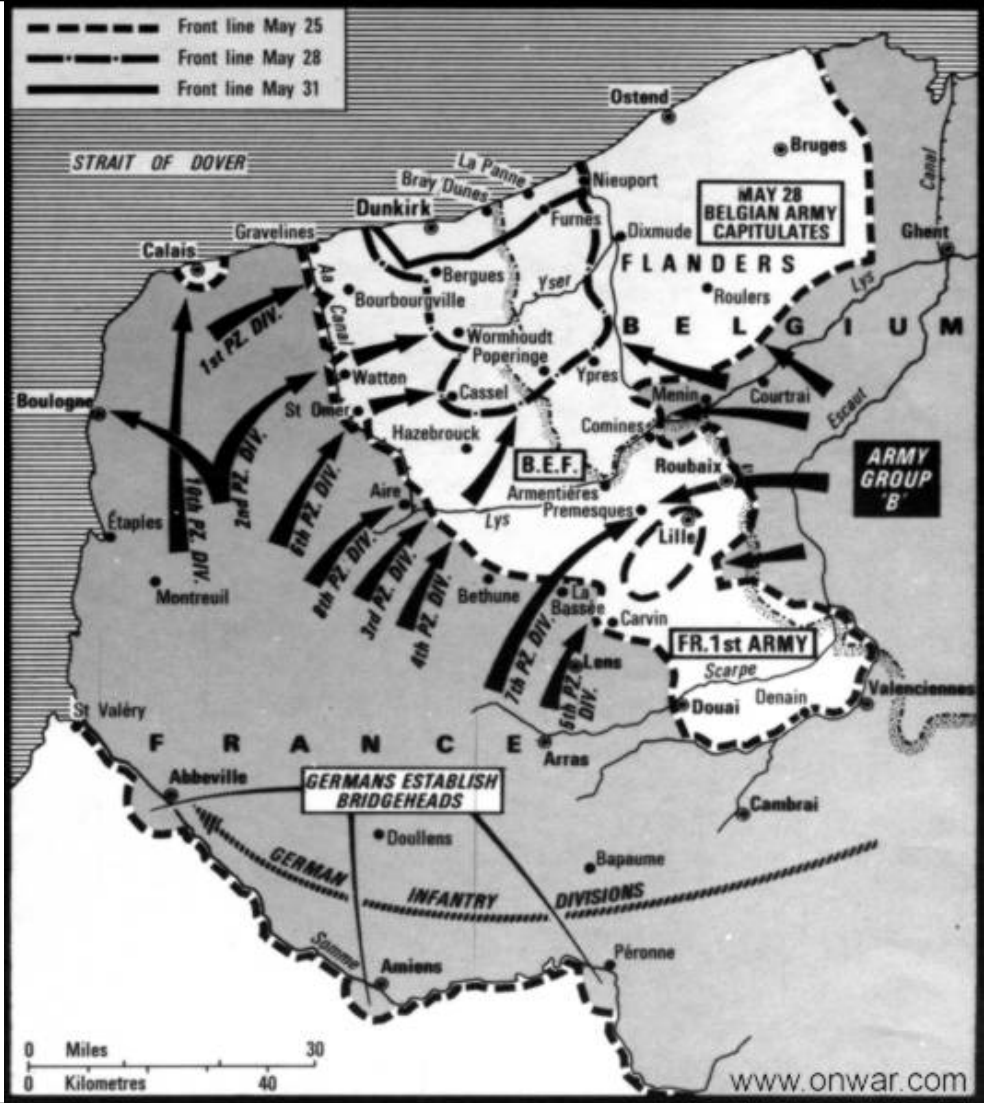
This is the story of how one man was brought in to fix fighter production in an incredibly short time to respond to a crisis

- In May 1940, the United Kingdom (UK) was facing a dire situation, an imminent air battle and invasion.
- The UK air defense was the last hope, but fighter losses in other theatres had reached critical levels.
- With the fighter production in disarray (supply-chain broken) Churchill had to turn it around in several months.
- The concepts of Supply Chain agility, Just-In-Time Manufacturing, and Zero Inventories, were introduced.
- Example of a demand driven Supply Chain in 1940.
- Please prepare questions for the end of the presentation.

LESSONS FROM HISTORY

On May 10th 1940 Churchill became PM and within 2 weeks he was facing the biggest military catastrophe in British History

- Day 1 – invasion in the West
- Day 5 – Holland capitulates
- Day 7 - Axis break through at Sedan
- Day 10 - Axis reach the English Channel
- Day 15 - 2 armies surrounded in a pocket
- Churchill was faced with a disaster, and asked his Chiefs of Staff to report on the problem of the defense of the UK
- The report stressed the overwhelming superiority of the enemy on land and in the air.



LESSONS FROM HISTORY

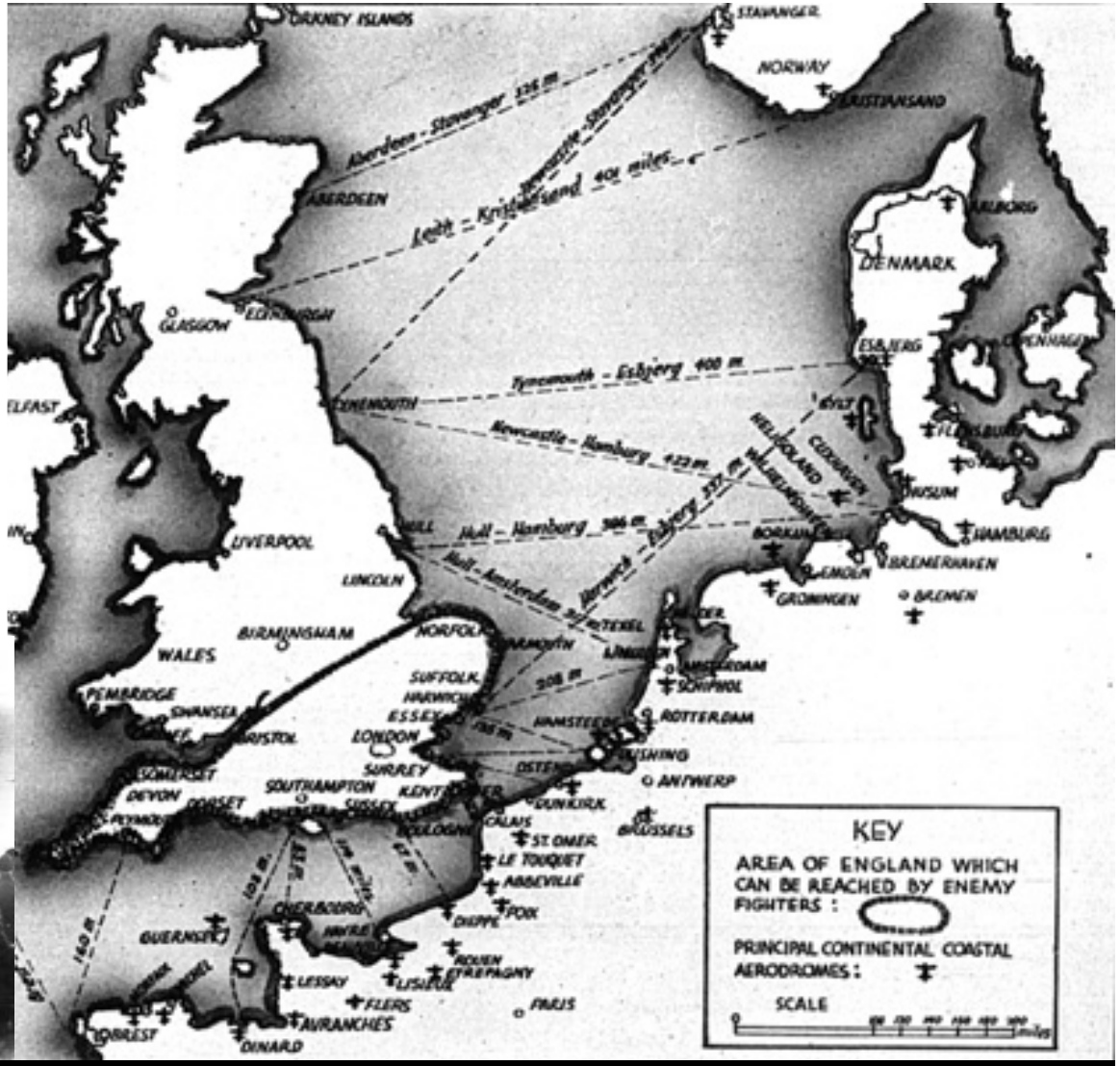
The cost of Dunkirk was incredibly high in losses of ship and aircraft

- In the last 2 weeks of May 1940 the Royal Air Force (RAF) sustained massive losses of close to 500 operational fighters in the air battle over Flanders and France.
- In total the RAF lost 1,029 aircraft and over 1,500 personnel.
- At Dunkirk alone around 200 ships and 177 aircraft were lost of which 109 were precious fighters.
- The Axis lost 240 aircraft.

LESSONS FROM HISTORY

With an army stripped off its equipment the RAF was the last hope but it was well below target nominal fighter strength

- With 620 operational fighters the RAF was well below its set target (in 1939) of 1,200 fighters, thought to be the minimum to win an air battle over UK
- The enemy was only 21 miles away



LESSONS FROM HISTORY

Fighter manufacturing prior to 1940 had not changed much from practices laid down in 1918

- **Antiquated practices from First World War.**
- **Fighter production rate struggling to meet targets**
  - 200 fighters per month.
- **New Spitfire fighter factory hadn't produced anything in 6 months**
  - Plagued by complexity of Spitfire's elliptical wings.

LESSONS FROM HISTORY

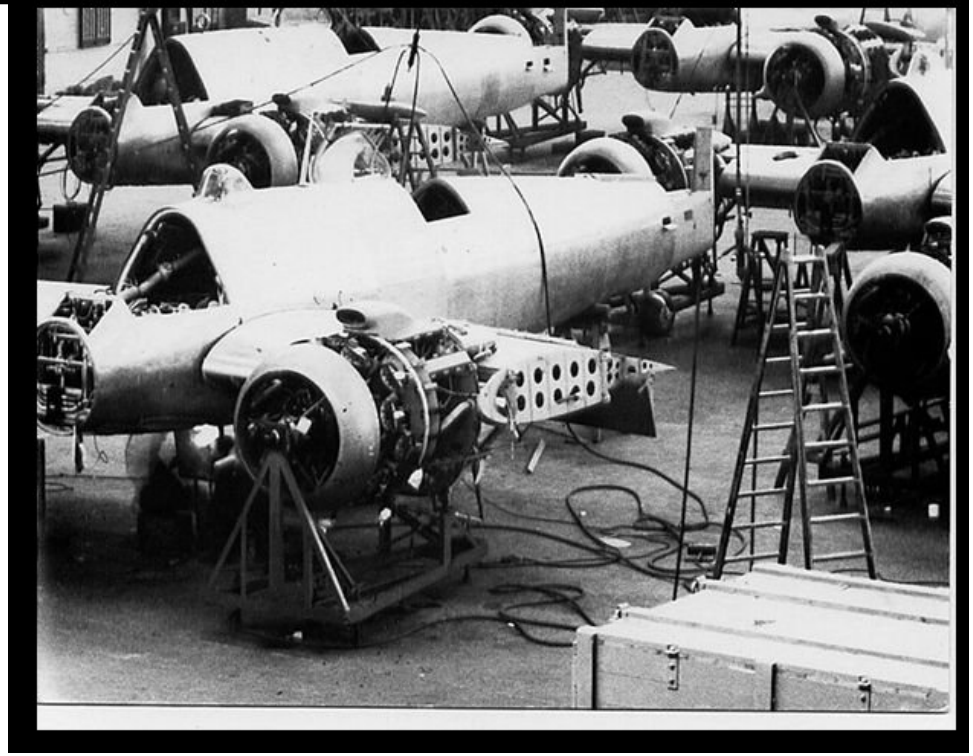
The UK economy was not geared for war never mind key weaponry needed by the RAF

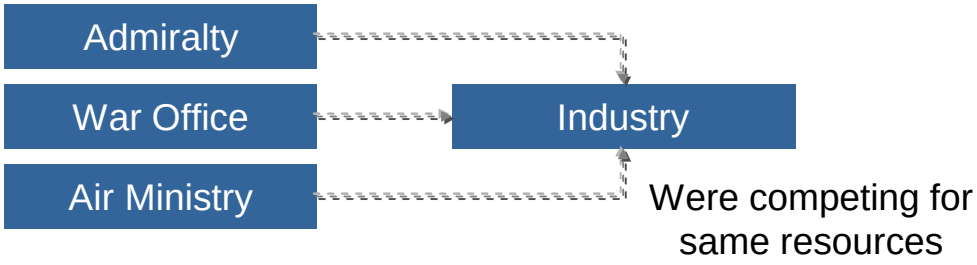
- UK vastly industrialized, over populated country.
- All raw materials imported (except coal).
- 67% of food imported.
- The UK economy was still on a civilian footing, producing household goods.
- New automobiles were still being built and diverting critical manufacturing resources and raw materials.

LESSONS FROM HISTORY

Churchill had to respond to the invasion threat and jump start fighter production immediately

- **Transformation needed through governance framework, and compliance.**
- **Churchill prioritizes fighter production over everything, even bomber production, the Air Ministries top priority.**
- **Churchill incorporates military structures into Storey's Gate, To limit competition and forces sharing resources /expertise.**
- **Creates the Ministry of Aircraft production (MAP)**
  - Churchill believed the Air Ministry had failed to meet its fighter production targets and had to be replaced.





LESSONS FROM HISTORY

Churchill wrestles fighter production out of the control of the Air Ministry and appoints Lord Beaverbrook as its minister

- Churchill needed a strong leader that could turn around fighter production.
- Beaverbrook a Canadian is a close long time confidant.
- Both served in the First World War cabinet of Lloyd George.
- Churchill could trust him and gave him a clear mandate to transform fighter production.
- Beaverbrook, newspaper magnate, no nonsense man could cut through red tape of bureaucracy.
- Beaverbrook an outsider who would take a very different approach.
- Beaverbrook could stand up to Churchill.

LESSONS FROM HISTORY

Beaverbrook new ministry and regime closely reflected his personality and the critical urgency of the tasks he had to face

- **The top levels were run by informal group of personal advisers from business and industry.**
- **Mr. Hennessy of Ford Motor's at its head.**
- **Beaverbrook's goal was to:**
  - accelerate production,
  - improve supply chain,
  - lock-step it to daily demands of RAF Fighter Command & keep it operational.
- **Beaverbrook had to:**
  - Plan raw materials and resources.
  - Collaborate with suppliers and manufacturers, across allies.

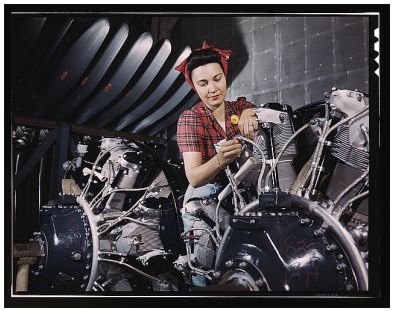
LESSONS FROM HISTORY

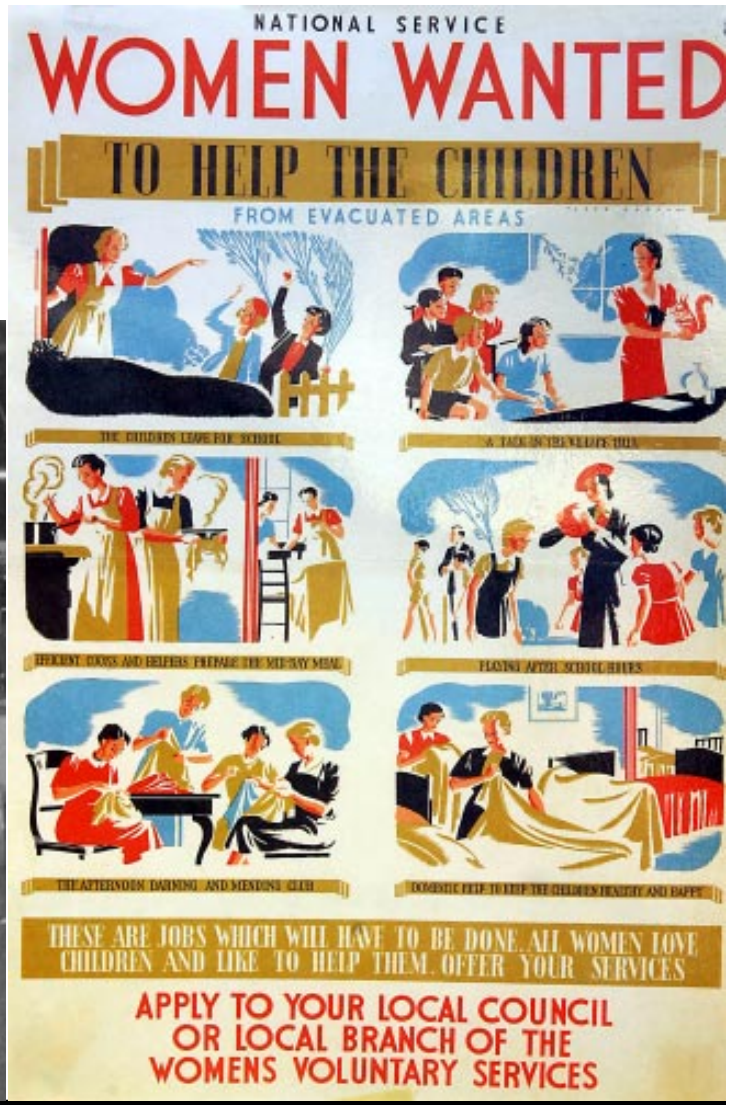
The military draft took its toll and created an acute shortage of workers and labor problems

- The Ministry of Labor ended poaching of skilled workers by rival employers.
- The Restriction on Engagement Order (June 1940) made it compulsory for recruitment to occur only through employment exchanges.
- Thousands of workers were directed out of civil industries into fighter production.
- Agreement with Beaverbrook that at least until the end of September 1940 all efforts concentrated on production of Hurricanes and Spitfires.
- If it was profitable then labor from other aircraft factories was to be transferred as well.

LESSONS FROM HISTORY

Women were encouraged to enter the workforce in large numbers to fill the gaps created by military conscription





LESSONS FROM HISTORY

Beaverbrook recognizes production rates of 200 per month are too low (by 43%) to sustain an air battle

- Beaverbrook aware average life of a fighter in war was 2 months
- Fighter force of 34 squadrons industry would need to produce 350 new aircraft a month just to maintain front-line strength.
- Battle losses could be replaced from manufacturing, reserves, or repair.
- Even with major increases in production losses would out strip these.

LESSONS FROM HISTORY

Beaverbrook introduced concepts of agility into fighter production to improve efficiency of manufacturing operation

- **Standardization**
  - It limited production to two proven types, Hurricane and Spitfire already in quantity production.
  - It immediately stepped up production.
  - It safeguarded already allocated materials & equipment.
  - It diverted from other types materials and equipment, and production capacity for immediate use.
  - It sourced aircraft parts from hundreds of large and small suppliers to ensure availability, to avoid bottlenecks, and a continuous flow.

- **Simplification**
  - It reduced number of small disparate components by shipping completed subassemblies from suppliers.
    - (fuselage frames, undercarriages, instrument panels, engines)

LESSONS FROM HISTORY

Beaverbrook also introduced agility concepts of modularity, & integration, to improve the efficiency of manufacturing

- **Modularity**
  - Supply chain expertise and best practices brought in from automobile manufacturing industry to speed up production.
  - Reusable components redeployed from bomber production and switched back with changing needs after the air battle.
- **Integration**
  - Business processes and infrastructure components in the supply chain for fighter production were connected.
  - Production broken from large factories to small dispersed facilities creating network of integrated manufacturing.
  - All fighter production facilities were top priority targets for the Luftwaffe.
  - In addition, new processes were introduced that eliminated the elliptical wing production problems.

LESSONS FROM HISTORY

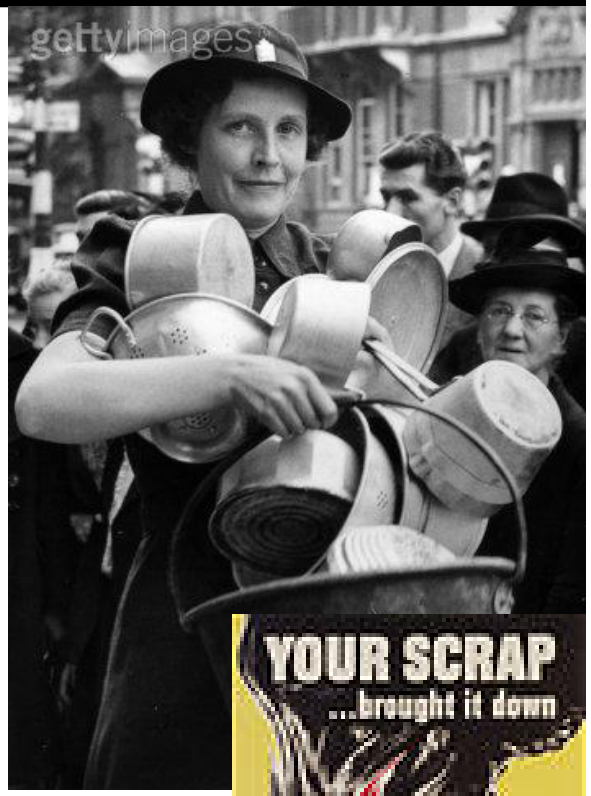
To create public awareness to the problem of production, and buy in Beaverbrook oversaw the creation of a Spitfire fund

- Spitfire funds where an individual, organization (Department stores) or town could present the cost of an airframe
- (for a Spitfire this was set at £5,000 ($20,000) although the real cost was nearer £12,000 ($48,000, or equivalent to £200,000 today)) and
- An aircraft would be allocated to bear the name of the donor on the fuselage.

LESSONS FROM HISTORY

An aluminum appeal that promoted people to save old pots and pans had enormous appeal and was very successful

- The appeal promoted people to save and donate old pots, pans and kettles and metal appliances.
- Posters were printed and newspapers ran adverts asking for old scrap metal to build fighter planes.
- In reality, little was used in aircraft construction.
- It boosted people's morale and they felt they were "doing their bit."
- Part of a concerted effort to get people more involved.



LESSONS FROM HISTORY

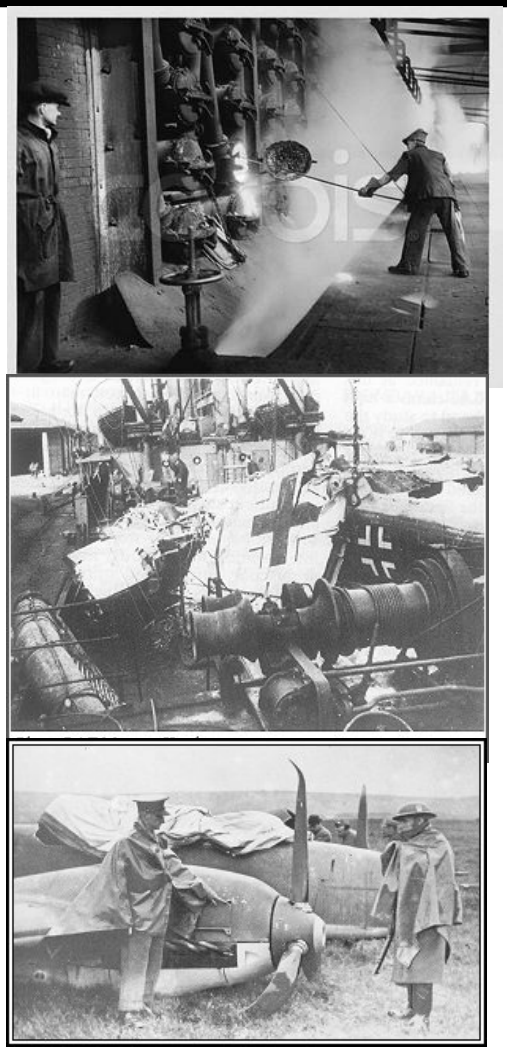
With raw materials scarce, Civilian Repair Organization (CRO) is put into operation to recover downed pilots and aircraft

- **In January 1940, Lord Nuffield:**
  - Created chain of repair shops and garages on RAF airfields, civil aerodromes.
  - Took over a number of large factory areas across the UK.
- **Bentley Priory (Dowding) directed CRO to crashed aircraft.**
- **Aircraft recovered on flat bed trucks, contributed by British Railways and London Transport, and taken to repair shops.**
- **Recovered aircraft were either immediately repaired or cannibalized for spare parts.**

LESSONS FROM HISTORY

Civilian Repair Unit No 1 established at the new Cowley South Works

- Also based at Cowley was the No.50 Maintenance Unit, which recovered any damaged aircraft from anywhere in the UK, and bringing it to Cowley for either repair or recycling in the No 1 Metal and Produce Recovery Depot (MPRD).
- New aircraft reclaimed from unrepairable wrecks by the Cowley MPRD smelter.
- In such a lean operation, even enemy plane were salvaged and thrown into the smelter.



LESSONS FROM HISTORY

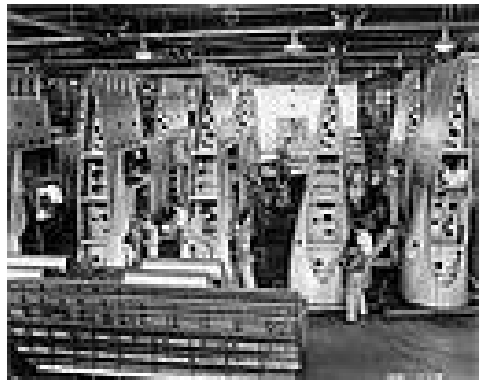
Civilian Repair Organization results show that even though it was a challenge it eventually paid off

- The CRO undertook repairs at a phenomenal rate.
- 60% of aircraft believed to be unrepairable at the aircraft stations were rebuilt.
  - By the end of 1940 the CRO repaired 4,955 airframes 33% of the total airframe output.
  - At the height of the battle, Fighter Command's total wastage was more than 180% of its operational losses, compared to 140%for the Luftwaffe's Bf 109s.
  - CRO provided 40% of the total output received by the operational squadrons. At the height of the battle, the CRO achieved Hurricane and Spitfire repair turnaround times of less than 6 weeks, employing a combination of depot, fly-in, and onsite repair.
  - Over 150 fighters were put back into the air during this crucial period - without them, 'the few' would certainly have been too few!

LESSONS FROM HISTORY

Beaverbrook also reached out to industrialist in US and Canada for procurement and production

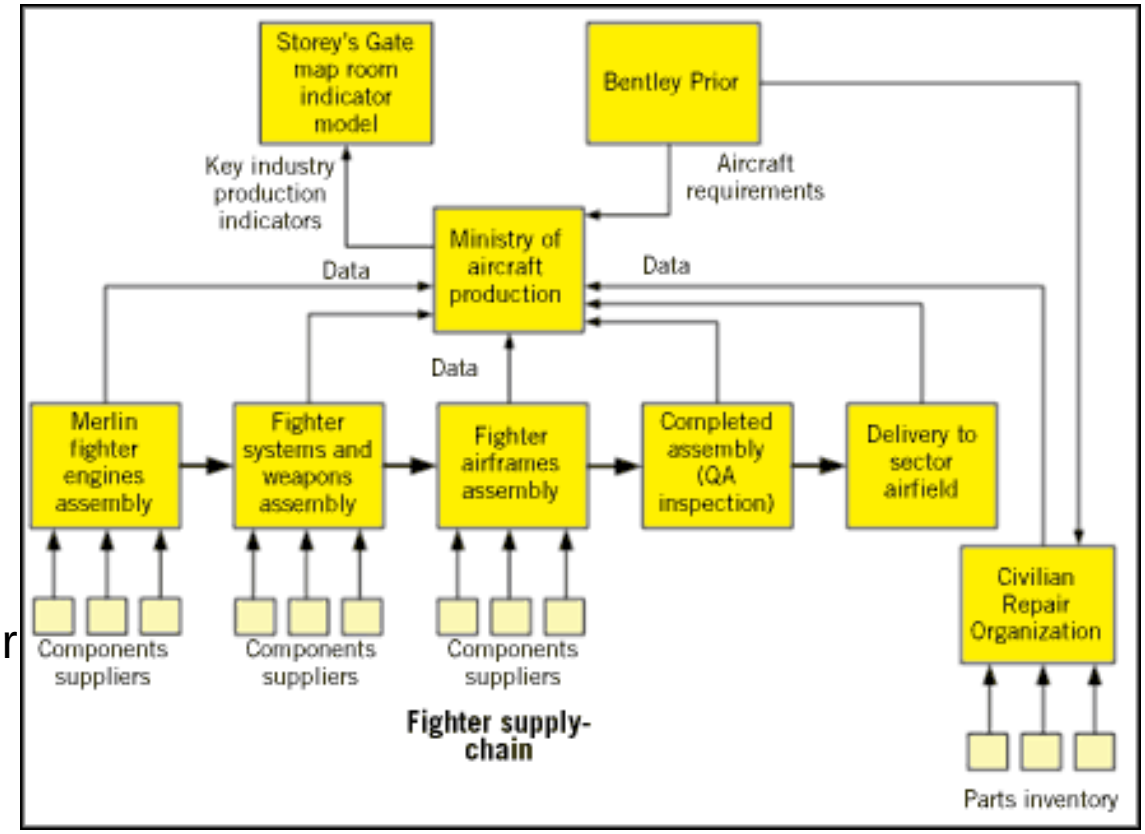
- Beaverbrook, a Canadian, had good relationships with US industrialists and leveraged these to secure supplies of precious raw materials and key parts and sub assemblies.
- In September 1940 Packard redesigned the Merlin engine for production in the US.
- Ford and Pratt and Witney



LESSONS FROM HISTORY

For MAP of supply-chain metrics (factories, shop floors, distribution centers, transportation, and RAF depots) was challenging.

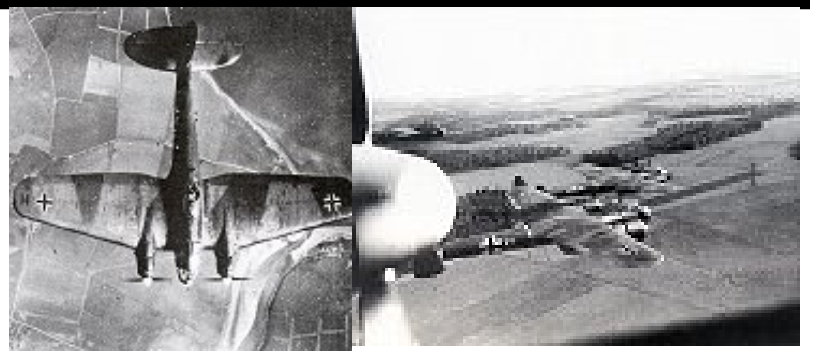
- **Input**
  - Production data collected
    - data counting
    - statistical techniques:
  - Sampling inspections, and defect estimates.
  - Information from supply-chain in various sources, and formats
- **Stored into a data store.**
  - Mechanized filing system for rapid access.
- **Output**
  - Passed to Storey's Gate & ministries in batch mode.



LESSONS FROM HISTORY

MAP expanded to embrace such diverse tasks like defending factories, aircraft storage, aircraft distribution

- **Labour, construction, regional services.**
- **Defense of factories with anti-aircraft batteries.**
- **Aircraft were dispersed to reduce the maximum holdings in each Aircraft Storage Unit from 400 to 200 aircraft.**
  - These provided a strategic reserve and buffer between the factory and front line to cope with surges in wastage and complete modification work prior to final delivery
- **Aircraft distribution to sector airfields.**



LESSONS FROM HISTORY

Beaverbrook was in close contact with Bentley Priory Fighter Command leader Air Marshall Sir Hugh Dowding

- **Beaverbrook and Dowding build very close demand/supply relationship**
  - To get in-depth visibility to demand plans,
  - Dowding had daily wastage (consumption) data to provide and the Daily Consumption Plan
- **Beaverbrook delivers directly to airfields (sector and group)**
  - Forecast accuracy improves
  - Establishes demand scenarios
  - Runs at zero inventory

LESSONS FROM HISTORY

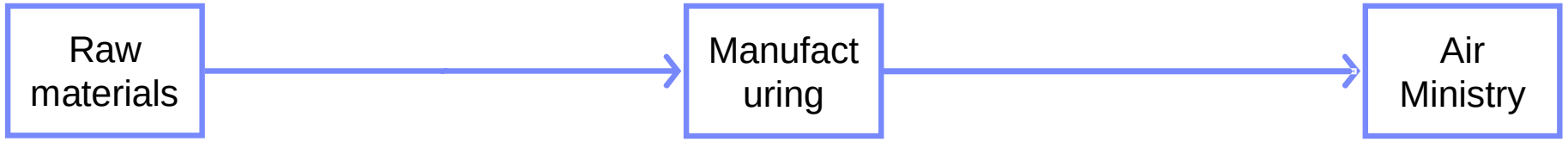
Beaverbrook's responsibility evolved over time to cover the whole supply chain

- **Beaverbrook's Ministry responsible for:**
  - Managing supply-chain, procurement, manufacturing and inspection, distribution, defending factories.
  - Civilian Repair Organization workshops retrieved/ assessed/repaired planes, or cannibalized parts.
  - Encouraging innovation & improvement of production processes and sharing free flow of ideas.
- **Supported by:**
  - Scientific Units:
    - Advised on new improvements on shop floor.
  - The Statistical Advisory Section.

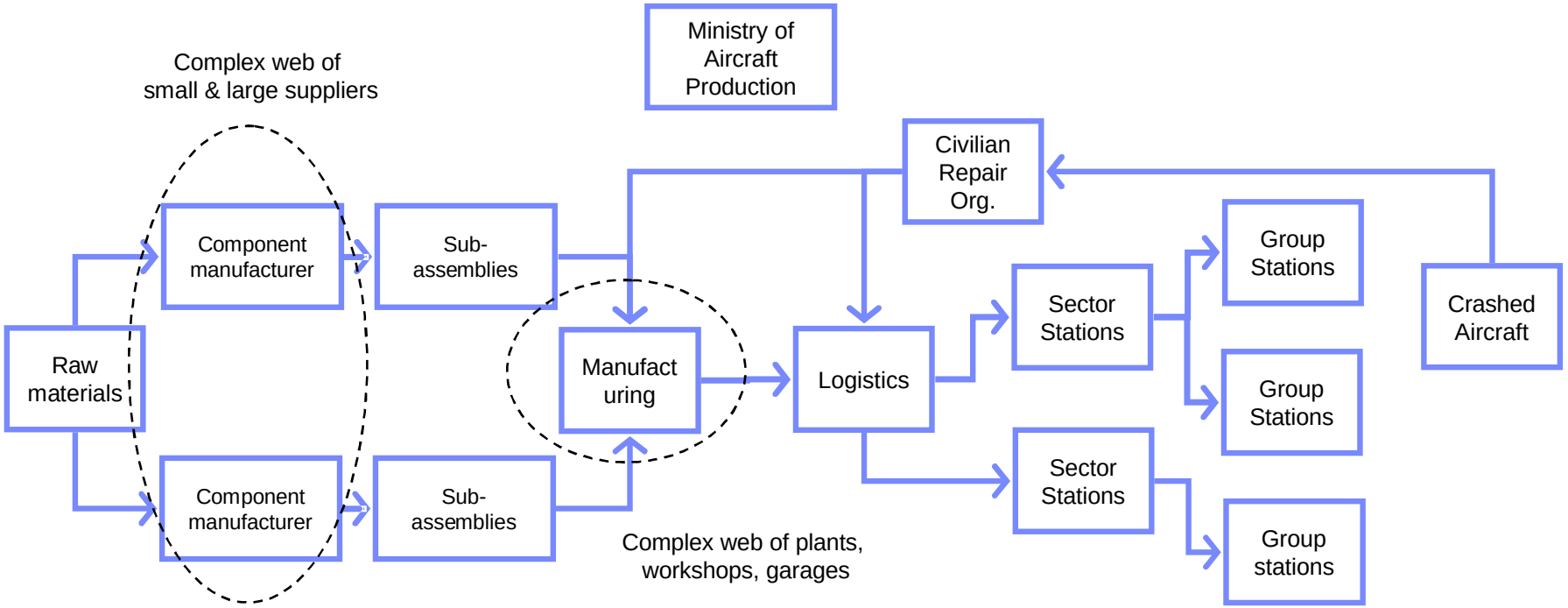
LESSONS FROM HISTORY

The supply chain evolved considerably in a few a months

Spring 1940



Summer 1940



LESSONS FROM HISTORY

The Supply-chain overtook Axis fighter production and adequately supported RAF to sustain a prolonged air battle

- **Beaverbrook's aircraft factories churned out 496 fighters per month, considerably more than the Germans.**
- **By the end of August, despite attacks of British aircraft facilities, fighter production continued to hit an astounding figure 476 per month.**
- **By the end of 1940, British factories produced 4,283 fighters, compared to Germany's 3,000.**

Month	Planned	Achieved	Overall Available
February	171	141	
March	203	177	
April	231	256	
May	261	325	
June	292	446	600
July	329	496	644
August	282	476	708
September			746
October			734

- **In 1940, only 1870 Axis single-engine fighters produced against planned output of 2412.**
- **The numbers of ME 109 built were:**
  - 164 - June,
  - 220 - July,
  - 173 - August,
  - 218 - September;
- **Total of 775 against Britain's 1900.**

LESSONS FROM HISTORY

Beaverbrook's Achievements – his astounding business acumen allowed the UK to quickly gear up aircraft production & engineering

- More aircraft were built than there were pilots to fly them.
- The CRO played a significant role and by the end of 1940 it repaired 4,955 airframes, 33% of the total output, or 4196 aircraft between July and December
- Beaverbrook's role was Supply and Demand Monitoring.
- "The work you do this week fortifies and strengthens the front of battle next week… The production you pour out of your factories this week will be hurled into desperate struggle next week." Beaverbrook, summer of 1940.
- Churchill declared: "His personal force and genius made this Aitken's finest hour."

LESSONS FROM HISTORY

Aftermath to the battle

- **Beaverbrook's approach to the supply chain was needed in the summer of 1940, but it distorted the supply system of the war economy.**
- **After the battle it was replaced by a quota system,**
  - each ministry allocated quota of raw materials based on priority in war effort.
- **By winter of 1940–41 urgency was truly over.**
- **In the summer of 1941, Beaverbrook transferred to the Ministry of Supply.**
- **MAP was brought into line again with the methods of the other ministries.**

LESSONS FROM HISTORY

Summary

- The Battle of Britain not only tested the pilots, their planes and tactics but most importantly it was also an attritional struggle that tested the supply chains of the air forces and the production, storage, repair, and salvage of fighters.
- In today's world what can we take away from this lesson-from-history. Churchill had a very clear view of the situation he faced and therefore was able to prioritize his objectives and shut down non essential war production. He was able to narrow in on fighter production and make it a priority, assigning a leader that could turn it around.
- Beaverbrook, an outsider took a very different approach to the supply chain, and introduced the basic concepts of agility. He mandated zero inventories to maximize the output and stuck to his principles, exceeding all expectations. Beaverbrook's supply chain was a significant factor in the story of the conflict.

LESSONS FROM HISTORY

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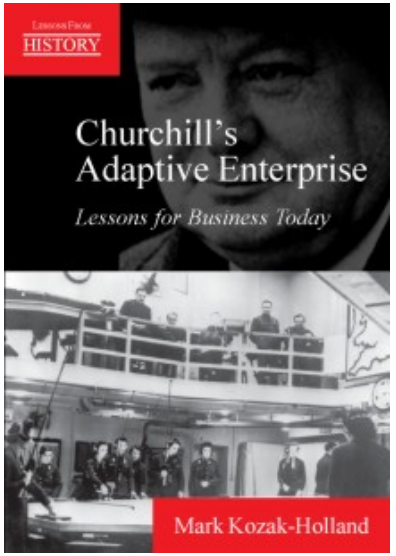

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