Ocean and Naval Architectural Design

Marine production

Product-oriented work-breakdown structure: integrating hull construction & outfitting & painting ~ zone production

- Hull block construction method
  - Hull sub-assemblies & blocks are produced in process lanes iaw 'group technology' principles.
- Zone outfitting method
  - Outfitting is done in conjunction with hull construction in 3 stages: on-unit, on-block (up and down), and on-board.
- Zone painting method
  - Preparation and painting done in conjunction with overall construction.
Marine production

Production hierarchy
- Fabrication of parts
- Assembly of parts
- Assembly of blocks
- Erection of hull
- Outfitting
  - See Fig. 3-7 & 3-24

Fig. 3-7: Hull block construction method (HBCM) manufacturing levels.
Marine production

- Zones for zone outfitting
  - On-unit, on-block, on-board
  - On-unit
    - A zone which defines an arrangement of fittings assembled independent of hull structure.
  - On-block
    - Assembly of outfit items on any structural subassembly. The ‘zone’ of on-block outfitting refers to any region being outfitted.
    - E.g. outfitting on a deck of a block that is right side up is a zone; outfit on the deckhead of the same block when upside down is another zone.
    - Work packages for outfitting zones are sometimes called ‘pallets’ & the outfitting plan is organized/scheduled by palletized work packages.

Fig. 3-24. Zone outfitting method (ZOFM) manufacturing levels.
◆ Zone outfitting

- On-board
  * A zone for assembly of outfitting at the hull erection stage or after launch. Convenient zones for on-board outfitting correspond to physical compartments, such as a bulkhead, a deck, a tank etc.
  * The less outfitting done on-board the better.
  * (why?)
  * Typical on-board items include very large/heavy items, fragile & weather sensitive items, connections between on-block fittings ... main engines, insulation, electronics.

◆ Zone outfitting

- Objectives of zone outfitting planning
  * Arrange outfit zones to maximize down-hand work, ensure easy access and open work spaces. This should improve productivity. This may entail rotating a block to facilitate outfit work.
  * Arrange outfit zones to ensure safety of workers.
  * Arrange uniform work content in packages to promote uniform work flow.
  * Design for production: increase the "on-unit" component of outfit.
  * See Fig.3-24.
  * Component procurement, unit assembly & grand unit assembly are independent of hull construction.
  * On-block & on-board are dependent on the hull construction processes.
Zone painting

- Objectives of zone painting
  - Minimize the painting done at the hull erection site and after launching. This is done by integrating hull construction & painting & outfitting.

- Considerations
  - Avoid rework (surface preparation and painting) due to cutting, welding, fitting etc. by waiting until the hull block assembly is complete.
  - Make use of paint hall.
  - Ease of work (as in outfit): down-hand work, access, safety.
  - Minimize scaffolding requirements.

- Steps (e.g.)
  - Shot blast & shop primer (raw structural components from stockyard), primer (anti-corrosive paint), finish undercoat, finish.

Zone production

- Zone production
  - Process lanes are integrated for hull construction & outfitting.
    - See Figs. 3-7 & 3-5 (look at the details).

- Zone scheduling
  - To control work flow on process lanes so that interim products are produced as required (not late, not early).
    - Progress is easier to track on zone basis.

- Zone costing
  - Cellular manpower allocation.
  - Materials lists are 'zoned' too.
Marine production

Follow the numbers:
- Hull construction process lanes (1 - 2 & 3 - 4 & 5)
- Outfitting process lanes 6-11
- Integrated hull & outfit lanes (blocks 4 & 5 + work packages A - C)

System-oriented work-breakdown structure ~ contrast with product-oriented WBS

- Hull structure, propulsion, electric, auxiliaries, outfit...
  - Systems have to be integrated but as many span the entire ship or installation, a systems-oriented WBS may have advantages.
  - Systems-oriented WBS is not conducive to group technology method. Product-oriented WBS is.
  - The breakdown of the ship/offshore installation into blocks and similar assemblies is geared to the product-oriented WBS.
Marine production

Product-oriented WBS ~ summary

- Product type
  - Hull
  - Outfit
  - Painting

- Product resources
  - Material
  - Manpower
  - Facilities

- Product aspects
  - Zone
  - Area
  - Stage
  - System

Production processes of similar types of work problems:
- Features: e.g. curved vs flat
- Quantity: e.g. 1-off vs small batch vs large batch
- Quality: e.g. of workers, facilities
- Kind: e.g. cut, bend, paint, blast

Production processes by sequence:
- e.g. fabrication, subassembly, assembly, outfit-on-unit, outfit-no-block, outfit-on-board

Hierarchical division of spaces (e.g. cargo hold, hopper tank, coffer dam etc.; superstructure, individual decks, cabins, etc.; machinery spaces...)

Structural & functional (e.g. longitudinal bulkhead, fire control)

References