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MAIN PRINCIPLES OF MODERN SUPERSTRUCTURE DESIGN

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ABSTRACT

A new outlook on working conditions at sea has been aroused. In several shipowning companies and among sailors there is an appreciation of the need for social and organizational changes on board.

This report shows how this appreciation is expressed through alterations of existing superstructures and methods used in planning new designs. It is centered on Norwegian shipowners' common main principles regarding superstructure solutions on different types of ships. This should give ample reason for cooperation between shipowners. Research shows, however, that the use of a clear planning process has been neglected among them.

No standard solution is given here, but according to the specific shipowner's wishes and needs there is room for several alternative solutions without losing sight of the main idea.

A more thorough type of planning is needed, with clearly defined phases in the building process to provide better solutions -- technically, economically and socially -- for the superstructure of the ship of the future.

PREFACE TO THE 1983 ENGLISH TRANSLATION

In March 1983 I talked to more than two dozen Scandinavian shipowners and researchers about trends in ship manning practices and their effects on design. Among those I met in Oslo was the architect Siri Schjetlein. Mrs. Schjetlein is well-known in Scandinavian maritime circles for her creative achievements in crew accommodation design. Her reputation is that of an imaginative designer with a good understanding of the importance of establishing a balance between technical, economic, and human needs.

During our conversation Mrs. Schjetlein gave me a copy of a report she had written under the auspices of the Royal Norwegian Council for Scientific and Industrial Research. She explained that the report embodied the essence of the useful principles she had learned during her years of experience in designing crew accommodations -- experience that included research, design (both preliminary and detailed), supervision of construction, and extended periods at sea aboard her own creations. She apologized because her report was written in Norwegian and had never been translated into English. I immediately volunteered to have that shortcoming corrected, and she agreed to cooperate.

After Oslo my next stop was Trondheim and the Ship Research Institute of Norway. There I showed Mrs. Schjetlein's report to Prof. Stian Erichsen and he agreed to find a competent student who could do the translation. That turned out to be one Atle Ellefsen, whose work I presumed to knead with a heavy editorial hand. I then sent the manuscript to Mrs. Schjetlein to allow her to bring it up to date and to correct my more egregious editorial blunders. This she did, and I join our readers in thanking her for her expert guidance and cooperation.

Please note that this is the first of a three-part series of translations dealing with current Scandinavian manning practices and effects on design. The others are:

Report No. 276 - "Accommodation Design," by Per Klem

Report No. 277 - "The Influence of New Technology on the Onboard Operations of Merchant Ships," Finnish Shipowners Association.

Harry Benford

Berlin (West) Germany
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PREFACE

This report is primarily intended for shipowners, coordinators of projects, architects and other designers. It is based on research activities and other projects carried out in the years 1970 to 1980:

- preliminary studies
- organization experiments on board the ships "Hoegh Mistral" and "Hoegh Multina"
- Systems for ship operation (SDS) and the seminars on ship superstructures
- projects and conferences

Extensive changes are expected in the shipping market in the eighties. Development tendencies are toward energy conservation and other cost reducing factors. This will influence crew numbers, and organization of work on board. The important thing here is how this will affect superstructure design in order to get a reasonably economic, technical and socially optimum total solution.

Designing new ships and transport systems requires a development of planning methods that are also able to take care of changes on the social side. Superstructure and the problems connected with it tend to enter the project at a stage that is too late in the planning process. This is due to shipyard production methods, to owner's policy, and to the fact that principles are not clarified before the discussion of details.

CONTENTS

I. HISTORY

The "old" ship

Speaking of the "old ship" means that something essential has happened to the new ones. We are in this report concerned with superstructures, even though development has been at least as great in the machinery space and cargo holds. "Superstructure" refers to the housing above main deck, and is taken here to mean the crew cabins, offices, conference rooms, recreation spaces, catering facilities, and areas given over to navigation.

In order to get an impression of the "old ship" one can take a look at the typical dry cargo ship, held unchanged for many years. It is well recognizable with its characteristic profile with a fo'c'sle, forward bridge house, midship house, and poop. The ship could carry twelve passengers and an average crew of 40-50.

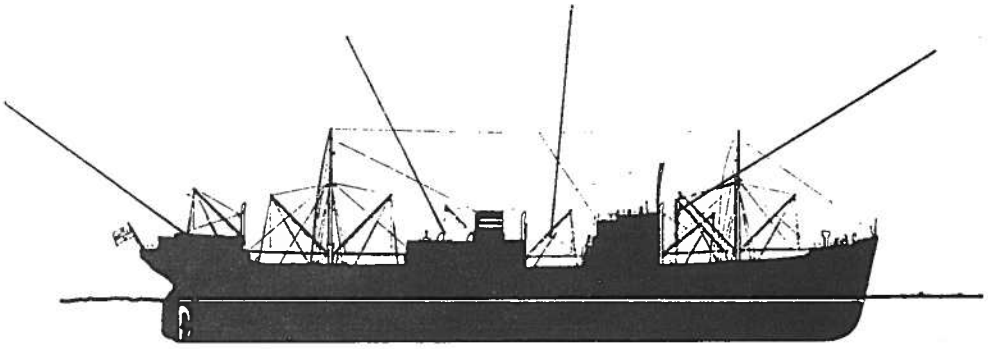


Figure 1. The old ship

The cabins were situated at three different parts of the ship. The passengers were accommodated in the bridge house with the captain and steward. Here the officers' and passengers' dining room and saloon were found, too.

Deck and engine officers and cooks had their cabins amidships, surrounding the engine casing. The rest of the crew were situated aft in two-berth cabins. The crew cabins each had an area of about 7 square meters with two berths, two closets, a small sofa, and desk. Two portholes gave light in the cabin. Two dozen crew members shared four toilets and six wash basins aft. Variations in size and comfort created six different cabin standards, reflecting the hierarchy of social status on board.

The captain's office was situated adjacent to his cabin in the forward deckhouse. The chief engineer, the steward, and first mate had offices in their cabins. No storage spaces or workshops were provided. Provisions were stored beneath the forward deckhouse, so food had to be carried over the deck to the midships galley. The bosun and the carpenter had their workshops in the fo'c'sle. Socially and professionally there was a sharp distinction between the various occupational groups. The lay-out of the superstructure emphasized these relations through its subdivision and distribution of rooms.

Food was served in six different messes. Unlicensed deck and engine crews ate in separate messes aft. The galley and three separate messes for junior officers, cooks, and senior officers were amidships. The captain dined with his passengers forward, in the dining room. The furniture standards were very different, from bolted benches and long tables for the ratings to upholstered, loose chairs in the captain's dining saloon. Three different menus were prepared each day, one for the crew, one for the officers, and one for the dining saloon. All the food had to be carried out from the midship house across decks to the aft and forward messes. Even in the midship house food had to be carried from the galley entrance aft through corridors to the officers' mess forward. Usually a "boy" and not a stewardess worked in the aft messes.

There were no recreation rooms for the crew. Usually they gathered on the hatches. Cinema and other arrangements were held on the "No. 3 hatch." If one, according to rank, lived amidships one had little contact with the environment aft. You simply didn't have any "business" there.

Despite all this, the "old ship" was a thoroughly proven and successful concept that embodied social conventions of its day. The technology of the ship was traditional and sailors were used to adapting themselves to the ways of life at sea, the tasks, and the technical requirements of the ship. Sharp class-distinctions were taken for granted. Crew accommodations were determined by the amount of "spare room" available. The legal minimum standard at sea was below conditions on land and far below today's standard at sea. The ship required a lot of labor but the labor was cheap and so the crew large. The model reflected a stable social reality.

The ship of the sixties

In the 1960's labor costs were rising so crew sizes were reduced. Concurrently changing and more varied needs of transportation, plus rapid technical developments led to one change after another without considering their effect on the total system. Ships grew bigger without any thought being given to new manning regulations. Difficulties in acquiring labor force necessitated not only a rise in wages and fringe benefits, but better living conditions on board. Food and accommodations improved, and thought was given to the need for space and equipment for spare-time activities. Still, the class-distinctions were maintained between the different departments and status-groups. As these groups started getting smaller the distinctions between living and eating quarters seemed more and more artificial. Gradually lines of division started to fade as the old ship society started to dissolve.

"OLD SHIP" CHARACTERISTICS:

ACCOMMODATION/SUPERSTRUCTURE:	SHIP ORGANIZATION:
Different cabin sizes. Largest: Captain Smallest: Unlicensed crew Standard differences: captain/chief eng.: teak paneling Officers: structure respatex* crew: smooth, cold respatex*	Underlines the traditional hierarchic ship organization, with distinct differences in status, differentiating between a "gentleman" and a "proletarian" culture.
Differences in berth sizes, bedding and cutlery.	
Different messes and dayrooms.	
Separate workshops/control rooms for deck and engine.	
Engine officers on port side. Deck officers forward/starboard.	Supports the traditional subdivision of departments.
Telephones without dials in crew cabins, messes and dayrooms. Telephones able only to receive calls.	Supports the traditional view that communication is something that comes from above and passes downward. Information required from the leaders.

Figure 2. from "Education, Ship Organization and Ship Design" (Norw.) (Karl Rogne 1974).

In the 60's the arrangement of superstructures tended to be rather awkward. Working conditions were poorly organized, being made difficult by poor traffic flow and minimum social contacts. Since then technical and social changes have necessitated increased cooperation between the various divisions on board.

*Respatex: Synthetic materials used for paneling, table tops, chairs, etc.

The need for change in 1970s' superstructures

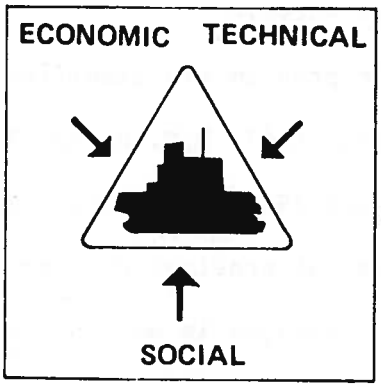


Figure 3. Changes in the surroundings of shipping and shipping companies

II. DEVELOPMENT IN SUPERSTRUCTURE DESIGN

Preliminary studies and field surveys

The main approach to the problem was clarified through preliminary studies in 1966-69 (E. Thorsrud 1967, P.G. Herbst 1969) and through field surveys on board ships (Roggema 1968). Results from field surveys in 1971 indicated that socio-technical alterations on board seemed to improve social contact and human relations. Changes in work patterns on board were also tested and improvements found.

The ship was described, not only as a working place, but as a "24-hour society" where people have their work, spare time, and private lives.

Several examples could be found where the crew themselves had changed the organization. In order to improve service and rationalize the labor effort in the steward's department, for example, they combined the messes into one restaurant for the entire crew. Their experiences were positive concerning both service, and labor and social satisfaction.

Topical views on the running of ships and superstructure design were debated by the Norwegian Shipping Employers Federation (SAF), the Labor Research Institute (AFI), corporate boards, and labor organizations.

SAF engaged a consultant to present a "good standard solution" for the ship as a working place and home. The opinion was that some adequate principles of planning had already emerged from the rationalization of the merchant fleet. In 1962 the Norwegian Shipowners' Association and the newspaper Norges Handels solicited opinions from Norwegian sailors. Topic of the survey was "A new ship is planned; what can be done to ease and simplify daily activities on board?" The abstract of the replies provided a good start in establishing some of those principles.

Others in SAF envisaged a prototype solution for recreation areas. The desire was that the recreation spaces should be centralized so as to encourage their use as social gathering places. During the planning it became clear that the recreation areas had to be seen in relation to working and living areas to provide an integrated superstructure.

Designing the recreation areas and evolving a "standard solution" were combined in a pamphlet called "Superstructures: About Planning" (Norw.) (SAF/NR 1972). The purpose of this pamphlet was to give some opinions on the tendencies seen in the development and show how it is possible through planning to come up with a practical accommodation. It was maintained that the policy of the shipping companies as regards personnel and management would be decisive for the design of superstructures almost regardless of the ship's type and size.

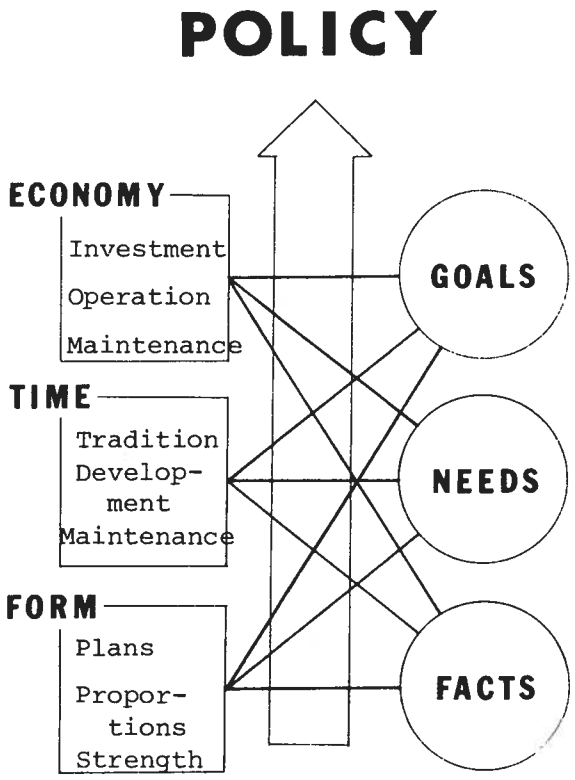


Figure 4. Factors affecting a shipowner's standards

Altering the superstructure of a series-built ship

In 1971 a group of shipowners altered the superstructures in the final 4 of a series of 13 ships. The ships had been contracted in 1968. The experience of the shipowners showed that the original design did not fulfill their new requirements. It was not simply a question of standards. They wished to reorganize the different spaces for work, recreation, and privacy. The main principle was to improve human relations and cooperation on board. Time was short; they were interferring with a series already under construction. However, the situation was such that cooperation between professions was possible. Great interest was shown by the participants in this work. They represented, apart from the actual shipowners:

- Other shipowners with experience from field investigations on board
- The Norwegian Institute of Ship Research (NSFI)
- the Shipping Directorate (a government agency concerned with maritime affairs)
- State Welfare Office for the Merchant Marine
- Norwegian Institute of Technology (NTH)
- Architects and marine engineers

The project cooperation was described in a pamphlet "Ship superstructures-a project study" (Norwegian Shipowners' Association SAF/NR 1973). The purpose of this was also to test the "tools" proposed in the planning method presented in the pamphlet "Superstructures: About planning." (SAF/NR 1972). New thoughts and ideas were at the same time made use of in planning a superstructure for three newbuildings.

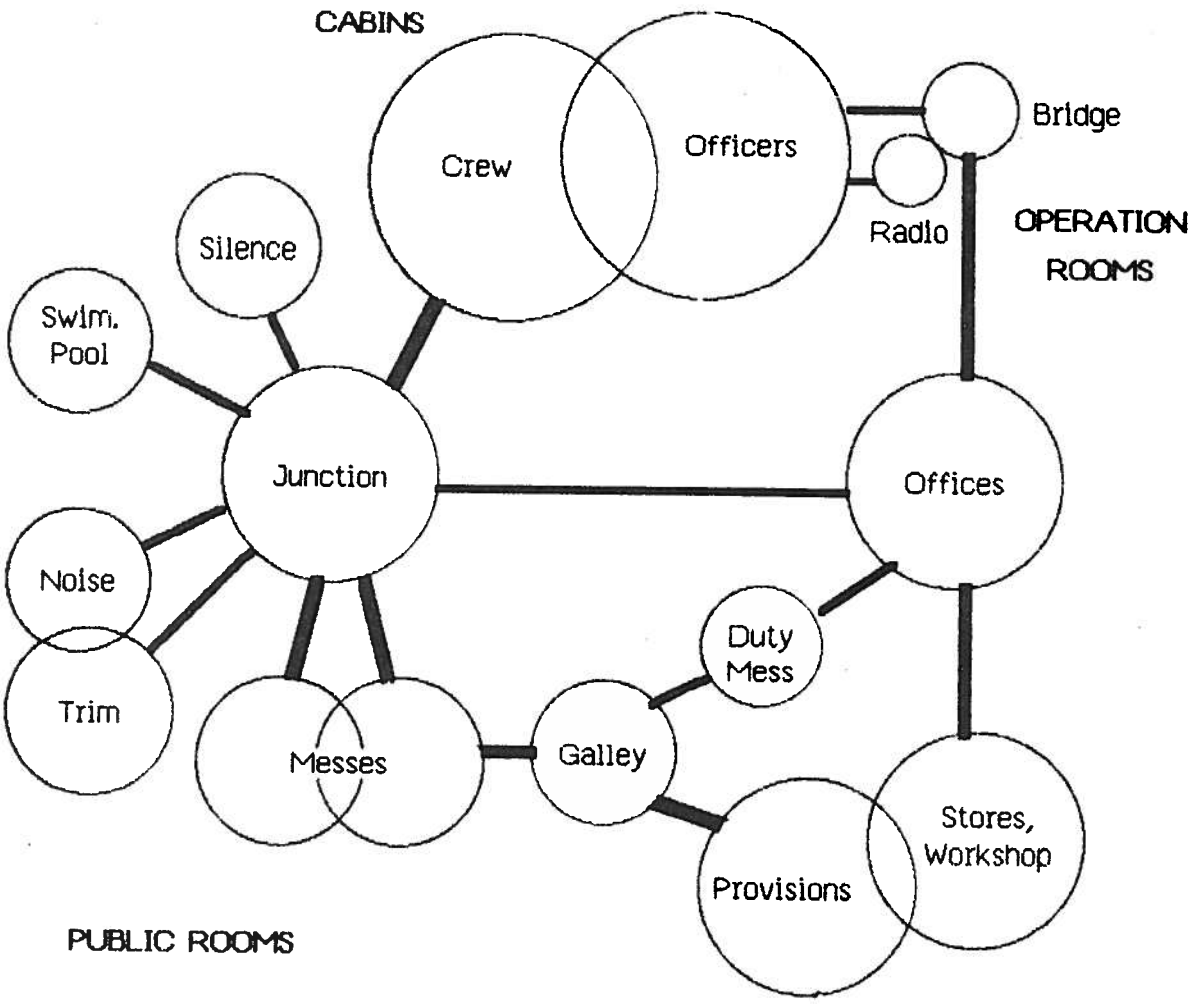


Figure 5. Contact diagram for the project study

Superstructure seminar 1973-74: A method of planning relevant projects

A method of planning was tried at nine seminars as part of a project called "Operating and Running Ships" (SDS). These seminars and subprojects 24 (Ship Superstructures) and 19 (The Design Process) were carried through as a team effort by scientist Karl Rogne, naval architect Per Klem, and architect Siri Schjetlein.

The intention was to aid shipowners in systematizing their work with superstructures. Simultaneously, experience could be gained and passed on to others concerned. It was accepted as an impossibility to come up with a superstructure that would satisfy every shipowner. Two to four shipowners participated at each seminar, working on the same type of ship but with separate projects. The participants, three to five, from each company, represented different departments such as technical, maritime and economic.

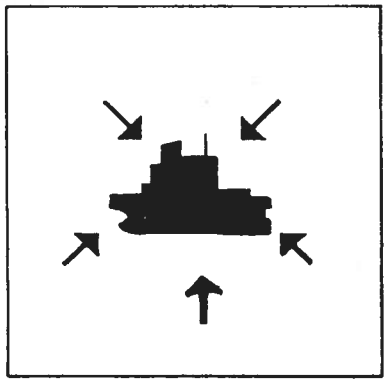


Figure 6. Participants in the planning process

The companies were asked to send representatives from their sailing personnel. An important point was to see that at least one of the representatives had the authority to make relevant decisions. This might later influence the company's policy. If possible, participants representing the builders were also present.

An important condition at the seminar was that the participants included craftsmen with knowledge not only of existing requirements for superstructures but also new requirements in the process of being ratified. All in all it was necessary to start with a broad awareness of developments and changes that could have an impact on planning the superstructure.

Important resources were seamen with experience beyond the terms of working organization and recreational relationship we have on most ships today. Others had knowledge of trends in related technical development. The authorities were also represented by the Shipping Directorate. Their approval is required for accommodations, and they know the regulations and new tendencies in international shipping.

The participants were given written information about vibration problems, important factors connected with training, office lay-out, etc.

As a preparation for the seminar, the companies were sent some questions regarding their future recruiting policy and work organization on board. This was to inform the participants about future conditions, and concurrently, the shipowners were requested to modify the design of their superstructures so as to induce a certain desired form of organization. (Karl Rogne, "Superstructures as an agent." SDS report 24, 1976, in Norw.)

The questions and answers were discussed at the seminar and gave the ship operating companies a chance to exchange views and agree on their requirements of greatest priority.

After the discussion, the operating companies worked out a single network diagram covering the functions the deckhouse is supposed to encompass. The diagram is a visual aid in formulating the criteria of area-use. Important criteria were human contact, communication, and desires of social division or integration.

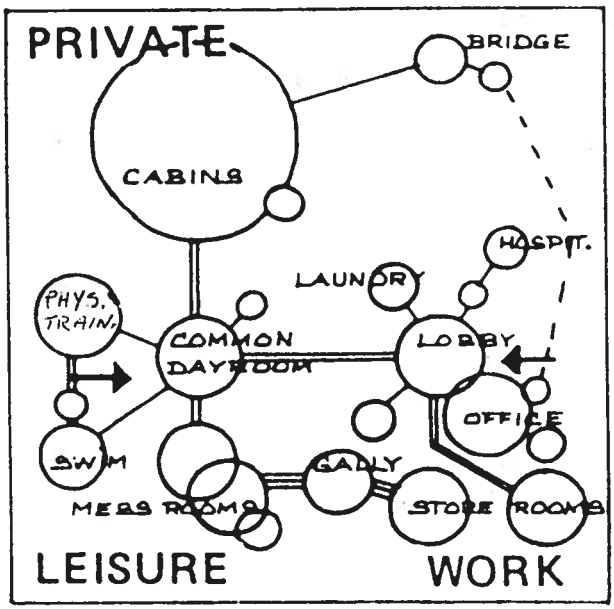


Figure 7. Contact network diagram

We asked the companies to keep a "logbook" while developing the contact diagram. They were to note the reasons for their choices. The contact diagram became a documentation of the company's policy and acted as a base for further project work, in addition to registering eventual future changes in policy. By working with contact diagrams it become possible to obtain an understanding of dependencies and at the same time, at this stage of planning, to avoid drawings and details that could distract from clarifying the major ideas. Companies with sister ships at the same builders could at this stage discuss and come up with a common problem formulation. The contact-diagram also revealed whether the shipowners managed specifically to follow their previous statements about such things as crews and form of cooperation in the future.

Information regarding crew size, cabin standards, need of area, total area, etc., for the specific type of ship was discussed and put into the system. This was an opportunity for the different shipowners to learn of one another's experience and support each other in the discussion of future arrangements.

From this given information, and the constraints imposed by the kind of ship in question, a rough distribution of the superstructure in a desired division between work, private, and recreation areas was carried out. The area distribution was then used as overall guidance for further subdivision. The possibilities of alternative detailed solutions were kept open. See Herbst, P.G., "Socio-Technical and Psycho-Dynamic Variables in Ship Organization Design," (III-IV) from Socio-Technical Design, Tavistock Publ., London 1972 (first published in Norwegian 1969).

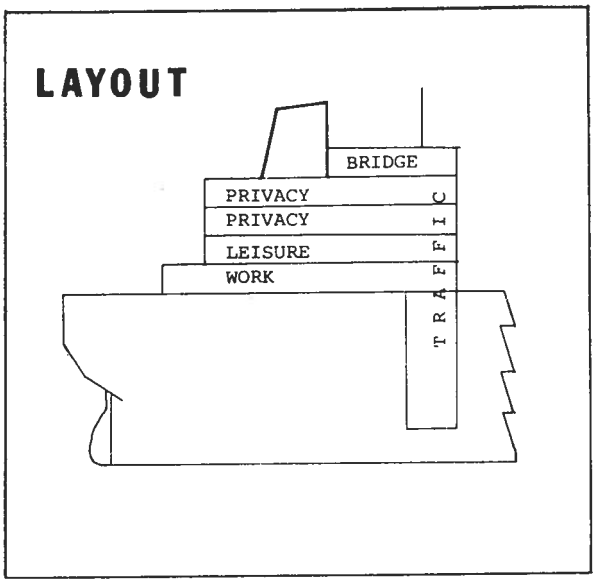


Figure 8. Area distribution

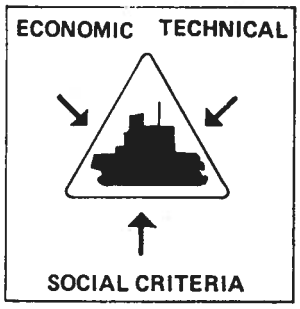
In order properly to "enclose" the "24-hour community" the area distribution had to be made to conform to the newly determined criteria for the choice of shipboard organization, personnel policy, and the contact diagram evolved by the participants. The operating company groups still had the opportunity to re-evaluate their goals without being tied down by drawings.

Cabins and private accommodations were dealt with first. If large cabin size in a small area is given priority, the consequence will of course be smaller recreation and public areas. Due to the participation of representatives from the builders at an early stage of planning, however, not all boundary constraints were found to be absolute. The builders also pointed out that an appropriate cabin module/shape could influence the frame spacing to some extent.

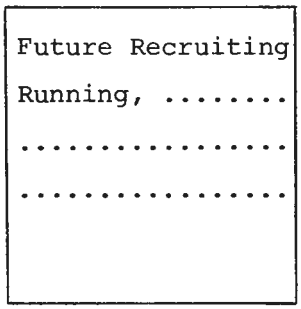
Having settled on cabin standards, the next task was to seek an optimal allocation of rooms within the available area. (In the long run some skepticism might be applied to some of the assigned limits.)

During the entire seminar the participants from each shipowning company worked together as a group. Frequently each company presented and explained its tentative solutions, for consideration by the other participants. In this way, different views on the design of the superstructure of the future were assimilated by the entire group.

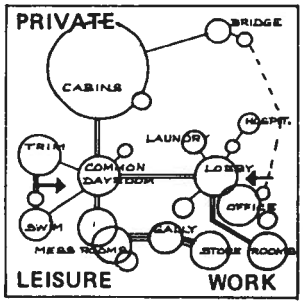
1. Surroundings



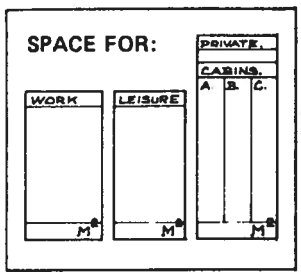
2. Policy Information



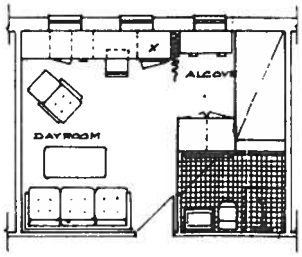
3. Contact Diagram



4. Systematizing



5. Alternative Solutions



Crew cabin.

6. Area Disposal

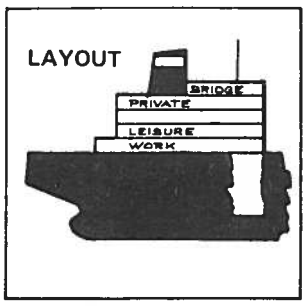


Figure 9. The process of planning

Each company then sketched out its revised general arrangement based on the main disposition. At later seminars the participants got together and presented their final solutions to each other. Details, as an important part of the whole solution, were treated at a final seminar.

Soliciting opinions from shipboard personnel was clearly a logical supplement to the seminars described above. In order to facilitate such a solicitation, a generally similar procedure was formalized and incorporated into a standard workbook. This was tried on three ships and then revised and enlarged for more general distribution.

Report summary

The sub-projects in the SDS project "Ship Superstructures" and "The Design Process" resulted in six reports (all in Norwegian) available at the Norwegian Institute of Ship Research (NSFI), Trondheim. These are:

Part I: MEANS AND CONSTRAINTS, showing:

- Correlation between work organization, recreation environment, and shape the superstructure
- Superstructure as a means of organization development
- Constraints and requirements
- The shipowner's possibility for a total solution is dependent on the design process
- Current design process, necessary considerations in the process, and suggestions for improvement.

PART II: EXAMPLES OF DESIGN - PROJECT SURVEYS, showing:

- The basis of the solution in sketches illustrating principles
- The drawings of eight deckhouses, designed at the seminars.

PART III: PROJECT BOOK, dealing with:

- The design progress of an example and user's "tools"/a method of design.

PART IV: AREAS AND ROOMS is a discussion about:

- Needs, sizes, and connections to other rooms
- Some alternative designs.

PART V: WORKBOOK ON BOARD seeks to systematize:

- The principal views of the sailing personnel.

PART VI: LECTURE ON ACCOMMODATIONS underlines:

- The necessity of good detailing of solutions.

Project continuation

In the years 1977-78 contact was made with 19 shipowners in order to hear their experiences with modern superstructures based on the material collected at the seminars. Most of the companies had participated in those seminars in 1973-74. Others owned ships of the same series used at the seminars.

Contact was made with:

- Seamen experiencing the new superstructure designs
- Builders participating in the seminars and
- The Norwegian Shipping Directorate.

A visit to one of the ships gave an impression of the seamen's opinions and the actual use of the superstructure.

Five of the eight superstructure designs developed at the seminars exist on ships sailing today. Some ships, being altered from a series, have sailed since 1972.

The contacts, interviews, drawings, and shipowners' magazines became the basis for an article in which the fundamental requirements for new planning methods are thoroughly detailed (Siri Schjetlein, "The Superstructure of Ships as an Expression of a New Vision of the Work Environment at Sea," AI-doc.31/78, Work Research Institute, Oslo).

The 1979 seminar: Superstructures of the future

In 1979 eight companies took part in an exchange of experiences in ship superstructures and a discussion of the ship of the future.

The purpose of the seminar was:

- Clarifying eventual common features and main principles as a basis for cooperation on the subject of superstructures,
- Describing and using a planning method,
- Identifying eventual common problems regarding: development tendencies, planning methods, and solutions for superstructures.

Invitations were sent to selected shipowners. Several had participated in the SDS superstructure projects. Collectively the participants from the shipowners represented most departments in the office and on the ship, even though only one or two took part from each company. Three shipbuilders' representatives took part. NSFI sent the project leader of "The Automation of Work Processes in Shipbuilding," which also covers superstructures. The Shipping Directorate was represented by people from the nautical office and manning office in the maritime department.

The companies were requested briefly to:

- Describe their work in designing superstructures and eventually how they prepared themselves for working on new projects.
- Give a reason for the solution of the superstructure they consider

fulfilling their future needs based on economic, technical and social relations.

- Identify eventual problems in their project work.

The companies worked at different levels in the planning of relevant newbuilding projects. Several had experience with ships having modern superstructures, and some ships were specially planned for a reduction of crew.

As an introduction the participants gave some views on:

- Expected changes in Norwegian shipping,
- The consequences for superstructure design to which these could lead.

Some presentations described current tendencies in:

- Cost reduction
- Energy conservation
- General social development.

Expected wage rates and a reduction in crew sizes were expected to require:

- Higher qualifications
- Shorter periods of sailing
- Altered working hours (longer).

Expected social development on land could have an effect on:

- Recruiting associated with labor market on land and career developments; for example a more open career at sea and an easier changeover to jobs on land
- Ways of running the ship (e.g., team sailing -- in which crew

rotation is carried out en mass, two complete crews alternating between ship and shore)

- Social relations on board.

The important things here are the consequences predicted by the participants to have an effect on superstructure design:

- A smaller crew necessitates small accommodation space with consequences, for example, for maintenance
- Improved relations and contact between crew members due to the increased use of public areas like mess, dayroom, etc.
- Less differences between cabin sizes and standards.

The representatives from the builders, the Shipping Directorate, and NSFI stated that:

- Construction by modules is rational and allows greater flexibility regarding cargo and passengers. Thought is also given to resale value
- Energy conservation will require extra thought to shaping the superstructure in order to minimize drag-forces induced by wind and motion. Aircraft carrier deckhouse might be considered.
- Weight reduction is attainable using alternative building materials like aluminum, which is about 50% lighter than steel
- Tightening safety regulations concerning dangerous cargo and dangerous waters may have an impact on the design.

Other possible savings were mentioned:

- Machinery modifications and reduced sea speed
- Balancing the choice of expensive construction materials against the

present value of life cycle maintenance costs

- Modifying maintenance routines and standards.

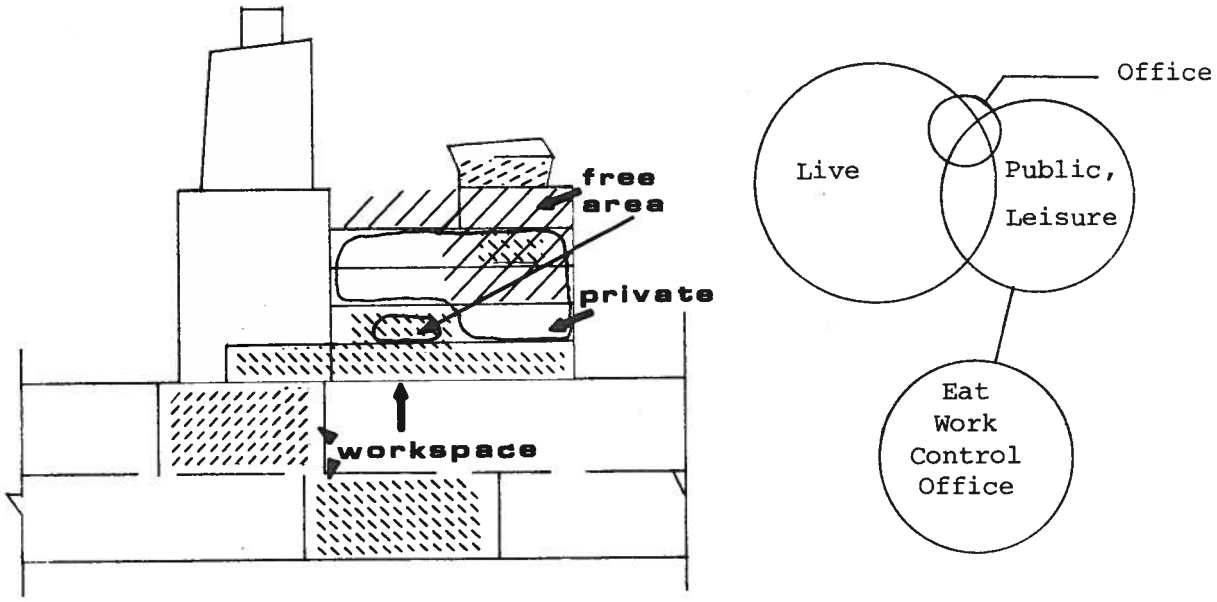


Figure 10. A schematic lay-out

Each shipowner presented relevant projects, ideas, or their newest superstructures, and gave reasons for their solutions. Different kinds of ships were represented. On this basis a schematic lay-out was drawn visualizing the main principles and enabling an evaluation and a comparison to be carried out between the different principles of solution. See Figure 10.

The description of project method for superstructures given by the owners was put up against four requirements of today's planning methods. The purpose was to see if any progress had been made in planning since the seminar days of 1973-74. The report of the 1979 seminar summarizes the main principles applied in laying out the accommodations discussed at that meeting. The report (available only in Norwegian) is by Siri Schjetlein: "Rapport fra Shipsoverbyggsummaret 1979."

Other pertinent activities

The U.S. Navy is concerned about improving shipboard living conditions. Weiler and Castle (1972) state that an "open" model for planning is needed for accommodations. "The planning must not only consider the experiences gained from existing ships, but must also look at changes in the American society giving consequences for the ship."

Other planning models referring to collections of data are found in report No. 86 from Svensk Skeppsforskning: "Working conditions and well-being of sailing personnel" (in Swedish), and Swedish interview surveys (Vickhoff 1973) among 217 seamen on 11 ships of the Broström Shipping Company.

In 1978 the Sealife Programme in England published a report called "Ship Design and Seafarers." It describes why ship design is important to seamen and why the process should be changed.

A year later Sealife Programme presented the report "Design Workshops Superstructure." Methods and experiences from the Norwegian workshop seminars 1973-74 were made use of. A participant from the SDS team "Superstructures" attended the British seminar.

The currently ongoing conferences "Ship Meets Ship" is a forum for exchanging experiences between crews of ships where new operating schemes have been applied, and in that connection the accommodations have been discussed. The secretariat functions are handled by representatives from SAF/NR, AFI and NSFI.

In 1977 the Norwegian Department of Shipping and Commerce appointed a task group to evaluate Norwegian shipping as a whole during the difficult world slump, and appropriate action that could be taken to preserve Norwegian shipping as an important part of national trade. Mr. Hermod Skånland became chairman. The report was presented in January 1978. In October of the same year a report was made by the Norwegian "Public Statements" (NOU 1978:13 skipsfartsnaeringen).

A report called "Automation of Work Processes in the Shipbuilding Industry" is available in Norwegian, published by NSFI in cooperation with ten shipbuilders. A part of the report deals with "Superstructures, alternative building methods."

III. A FRESH VIEW OF WORKING CONDITIONS AT SEA

In recent years there has been a growing understanding that social developments in Norway are affecting working, living, and social conditions on board merchant ships. It is presumed that the legislation on working environment on land will gradually be adapted to the merchant marine. More shipowners are now seeing superstructure design as a means of improving social and working conditions on board at the same pace as that on land.

There is in general an understanding of the ship as a unit, technically and socially. A unit where work, living, and recreation must harmonize in their functions. But the progress in transforming this realization into a physical solution is rather casual in most shipowning companies. There is no clear design process enabling trial and error along the way. The planning tools presented by SDS in their reports could have been used more efficiently.

Owners' opinions of superstructure design

"Working on superstructures is making use of a sum of experience from earlier days," says a shipowner's representative, as if there were nothing else to it. Others are of the opinion that "they get stuck in their experiences, which are mainly concerned with technical and economical aspects."

Few shipowners give time for planning in the early stages of superstructure design.

People are still talking about "hotel arrangements" as something separate. Therefore, little cooperation is seen between the departments when developing superstructure designs.

Some companies have a clear goal for their project work and are willing to consider new approaches to cooperation. They claim that "New production

and transport philosophies require a special project organization, allowing other means of cooperation in construction, manning, and maintenance.

Several shipowners are quite clear in their policy. One such company, indeed, publishes its policies in a workbook (commonly referred to intramurally as the Bible). These policies are applied to newbuildings as a means of attaining new forms of shipboard organization.

Seafarers are today conscientiously consulted during the design stages of new construction. Questionnaires are used, and accommodation models are used to facilitate understanding of what is proposed. Examples of feedback are shown in the fifth volume of the NSFI reports mentioned on page 15.

The crew's view

In general seamen are now more open in their relations to their company than before and show greater interest in their working place. More of them now understand the connection between work routines and superstructure design. They also see the benefit of centralizing the ship's several offices and archives. This was brought out in the 1962 survey mentioned on page 6.

The authorities' understanding

The authorities have shown signs of understanding shipowners' goals in superstructure design. This is followed by the Shipping Directorate with suggestions for revising the requirements for situating and fitting crew accommodations (7 March 1973). A revision draft 13 May 1977 is not evaluated yet.

New superstructure designs

In spite of difficult times in shipping, new thoughts have been expressed by changes in existing ships and in new solutions tried on several newbuildings.

From idea sketches, drawings, and completed projects on different types of ships, some main principles for superstructure design have emerged. A number of these are explained in the following paragraphs.

When it comes to placing the superstructure, the overriding demands of cargo capacity and cargo handling must be recognized. This tends to push the accommodations as far aft as possible. But shipowners are all the same concerned about situating the superstructure at a more vibration free and quiet place. Figure 12 represents a compromise location. Technical requirements are still supposed to have been taken care of.

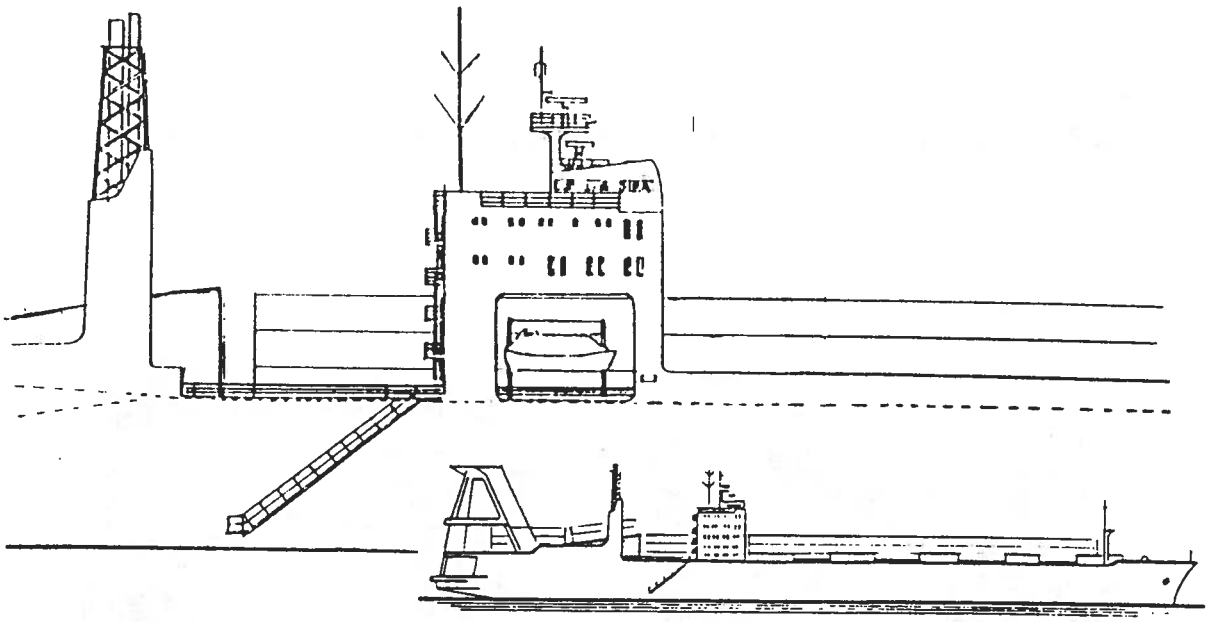


Figure 12. Ro-Ro ships. Example of superstructure placement.

Principally, the shipowners find that a division between functions and not status is required on board. In designing a "24-hour community" this means a division between spaces for work, recreation, and privacy. This can best be solved by area distribution according to functions, but has, regrettably, not often been done.

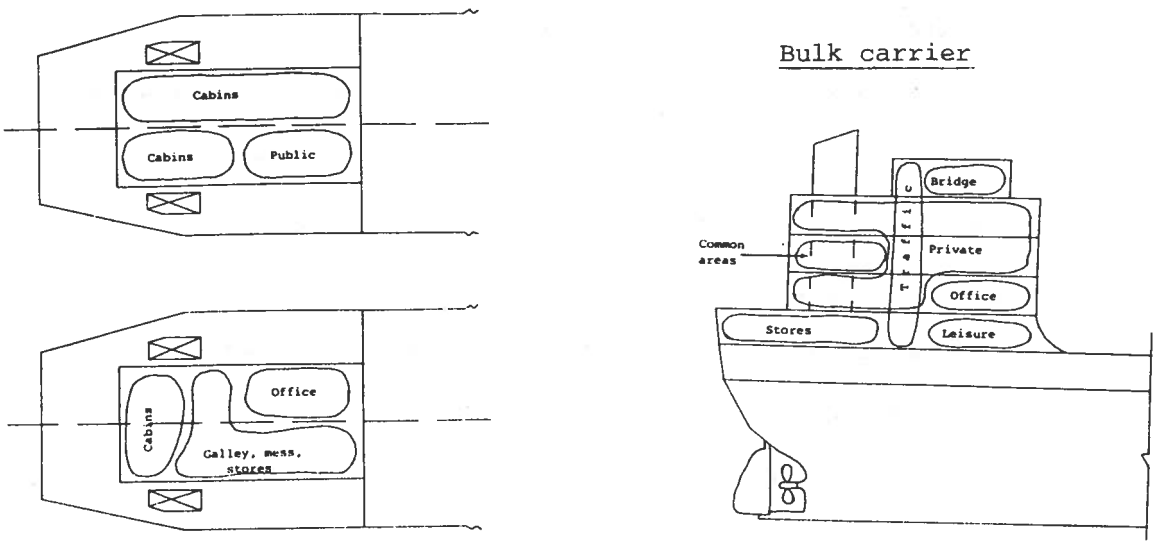


Figure 13. Main idea: Grouping functions into areas.

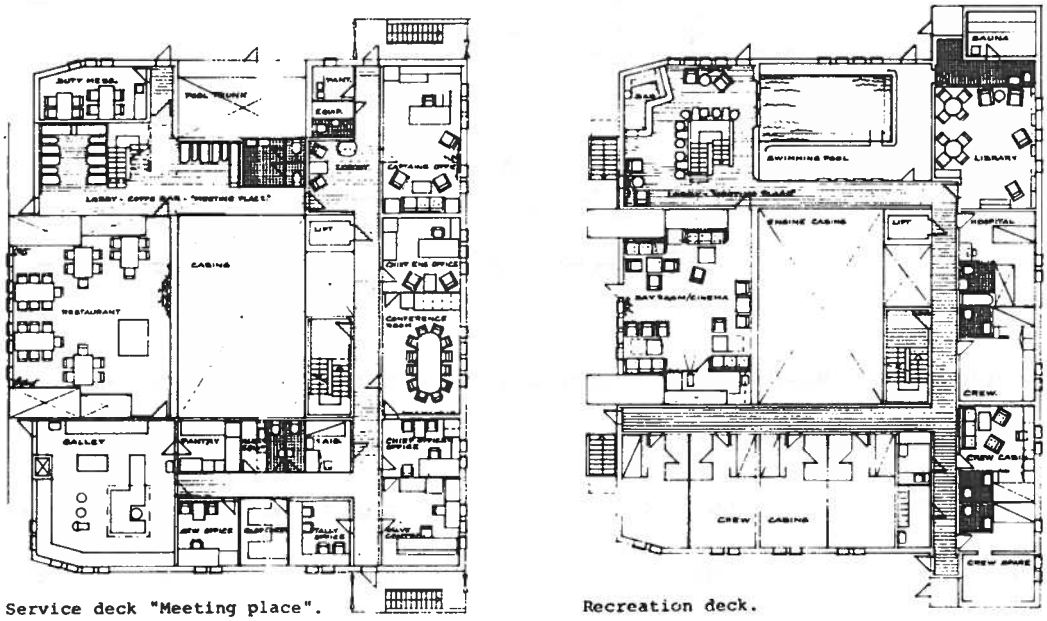


Figure 14. Sample accommodations.

Communication, including transport, traffic and contact between personnel, has been improved. Shipowners are aware of isolation problems on board and see informal contact as a way to avoid these. In the design this is done by regulating traffic so as to increase the chance of personal contacts. For example, a junction hall, and fewer corridors are employed. Several solutions show the communications and service center at the poopdeck level. See Figure 15.

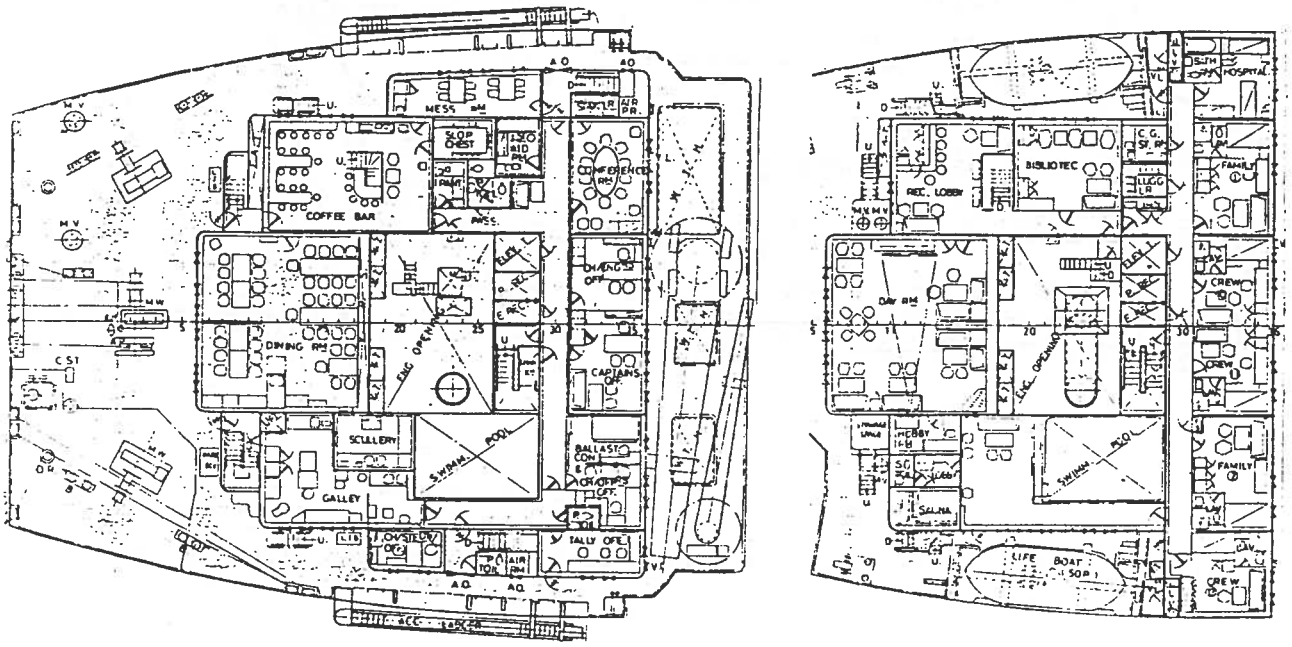


Figure 15. Arrangement to encourage frequent contact.

Some alterations were derived from the crew's experience and needs. In principle one is talking about "Further development of organization forms," "team sailing" and "working environment."

The actual WORK PLANNING on board is seldom treated by shipowners in conjunction with superstructure solutions. There are great variations in the placing of offices. A common control room for bridge and engine has been

suggested as a simplification in ship management.

Some shipowners favor shared recreational facilities, allowing officers and crew a range of activities approaching those available on shore.

Figure 16 shows recreation activities mainly connected, but separated into noisy and quiet activities. (See also Figures 14 and 15.)

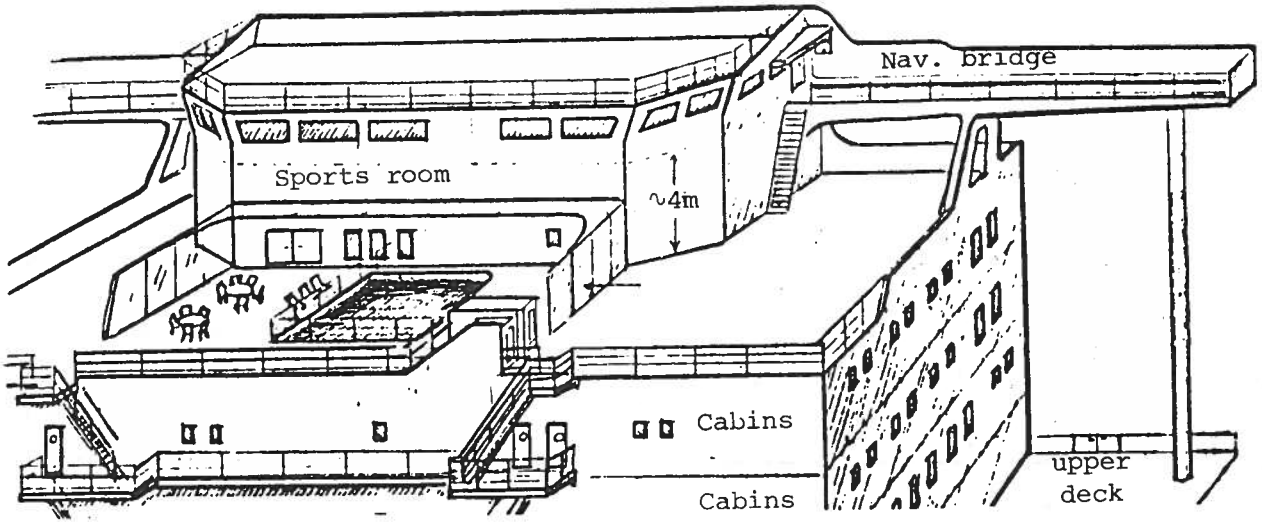


Figure 16. Recreation activities on the bridge deck.

(The appendix illustrates the crew's wishes in the form of a diagram.)

Shipowners principally agree on the need for suitable living quarters for officers and crew. A top requirement is for privacy -- meaning a private cabin or apartment for each member of the complement. Often, such private quarters can be adjusted to accommodate spouses. In spite of this, the actual superstructures still show great differences in cabin sizes in one and the same ship.

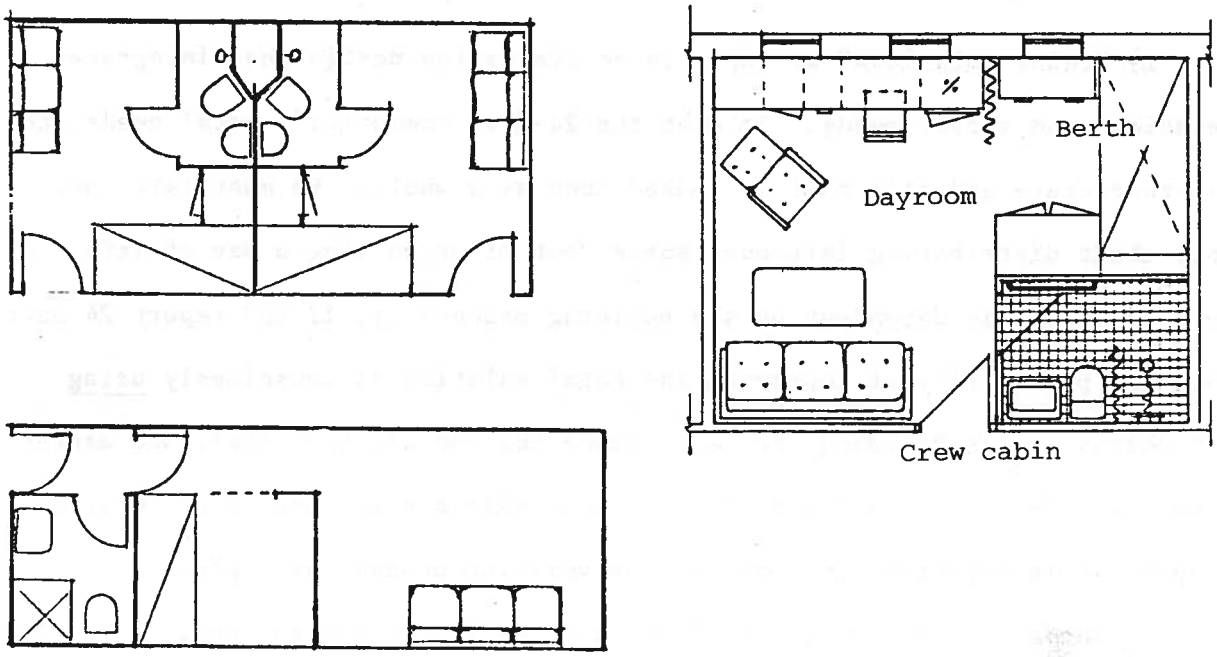


Figure 17. Typical cabins or apartments.

IV. POSSIBLE IMPROVEMENTS IN FUTURE SHIPS' TOTAL SOLUTIONS

By "total solutions" we imply an accommodation design that integrates technical and social needs. To meet the 24-hour community's total needs, the superstructure and ship must be looked upon as a whole. We must talk not only about distributing left-over space, but of organizing a way of life. A total solution is dependent on the building process (p. 12 SDS report 24 part I). One possibility of improving the total solution is consciously using the phases of the building process. Since the social, technical, and market constraints for various types of ships and their designs are under constant change, it is important to consider the building process as a phase development and to be conscious of which phase is the current one. A new form of planning is therefore necessary.

Requirements of today's planning sequence

The seminars in 1973-74 showed that by spending time on clarifying principal questions in the initial phases of planning, alternative solutions more appropriate to present and future needs could be found more easily.

But there are several opinions on what good planning really means. Very often it means going further into detail with all specifications and that these should be coordinated by a central committee. This is not necessarily favorable in designing ships and superstructures. It might be useful to have a look at some fundamental requirements in planning methods today.

A first requirement is that our planning methods should allow us to give social factors the same weight as technical and economical factors.

A second requirement is that new planning methods should give sailing personnel an opportunity to influence the design and, therefore, their own working and living conditions.

A third requirement is based on the fact that technical, economic, and social conditions may change during the planning stages of the ship. It is therefore important to lock in a minimum of decisions at each stage of planning. This is possible through what Herbst has called "minimum critical specifications" (Herbst 1974). Herbst points out the importance of "open design," giving a possibility of learning and development during the planning and design process.

A fourth requirement arises because changes in any one of the facets (i.e., technical, social, economic, or organizational) will have, to a greater or lesser degree, some effect on the others. It is therefore important that planning takes account of the mutual dependencies in the different areas, that is, for example, in the living areas and a certain part of the work area such as the offices. If a good solution is expected, both technically and socially, it will also be necessary to seek an effective means of communication between the participants in the design work.

The process of building, in outline

In order to discuss the solution of a construction project, one has to look at the overall building process. Generally, this is divided into five phases. Each phase represents in principle a piece of work to be terminated before the next phase begins. Let us show these in outline and then explain our thinking in more detail.

Phase 1. Programming: What characterizes the programming phase is that it is "open" for:

- Collecting information/ experience/ ideas
- Evaluating/ systematizing/ visualizing
- Alternative sketches of principle, giving a possibility of seeing the consequences of design.

This phase is primarily handled by the shipowner.

Phase 2: Design: In the design phase decisions must be made and "frozen" in the drawing:

- Preliminary design
- Working design
- Detailing.

Phase 3: Contracting: The contracting phase comprises:

- Specifications
- Bids
- Contract.

Phase 4: Production: The production phase includes:

- Production planning
- Production
- Delivery.

Phase 5: Experiencing: The experiencing phase includes:

- Project evaluation
- Management
- Improvements and ideas

The Process of building, in detail

Phase 1, Programming: From the requirements recommended for today's planning method, and based on the phases of the building process, some suggestions can be given for further work in the design of superstructures.

Improvements in the ship's total solution requires the shipowners to work consciously in their programming for the superstructure. A thorough program is a condition for enabling the designer to come up with an approximately optimal solution. It is advantageous to spend time on phase 1, programming,

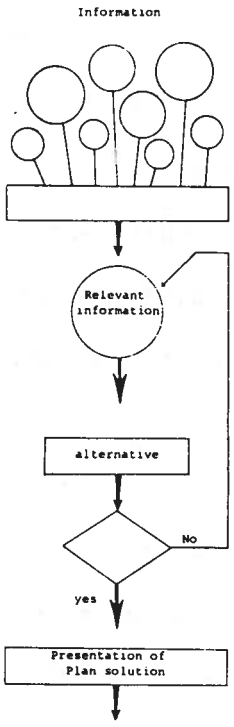
because drawing and redrawing is expensive and time-consuming.

From the ideal requirements for planning methods one should generally be clear as to:

- WHERE there are problems/possibilities in the building process
- WHAT is concerned
- HOW to work on the problems
- WHO should take part in this work.

The designers should in practice distinguish more clearly between:

Programming, Phase 1	Designing, Phase 2
Information, evaluation	
Discussion of principles	Initial design
Systematizing	
Visualizing	Detailing
Alternative principle schematics	
Choice	Main project
"Idea bank"	
NO DRAWINGS	DRAWINGS



As a lay-out for the design in phase 1 it is necessary to systematize and visualize policy and discussions of principles, goals, needs, and facts. The total view of the task must include relations between design of the super-structure and the working, living and recreation environment requested. The use of contact diagrams (Figure 7) gives a possibility of seeing mutual dependencies between alternatives and choices in various areas without getting tied down by drawings and details.

The contact diagram can be regarded as a "regulation plan."

Figure 18. Program

If a clear distinction between the phases for programming and designing is made it can be seen that the possibilities of participation is greatest in phase 1. Designers taking part in this phase have the opportunity to collect information and experience without the individual participant from the office or on board becoming a "hostage" for an idea.

Our project studies have shown that designers are too apt to start the second phase before the first phase problems are solved. This has led to locked-in details that do not suit the seafarer's real needs.

In the shipowner's planning of the superstructure it is important that the sailing personnel's own ideas and experiences be expressed. This is not acquired by asking isolated questions of seafarers representing the different departments on board and separated from each other and the ship itself as a unit. The different departments have to look jointly at the ship as a whole. Seafarers' opinions are most valuable at this programming stage. At any later stage, relations and dimensions are too locked into place.

Experience with the work-book (see page 15) shows that sailing personnel have no problems in working out contact diagrams and in that manner formulating their needs. Such an aid can in the same way be used for detailing individual work places like the bridge, the galley, etc. See appendix.

An important task for the seamen in phase 1 is planning their work routines and pointing out where their functions should be placed and the amount and shape of space needed. This is the main basis for the design of working places on board.

The architect should be heavily engaged in the programming phase. Before starting the design, the architect should become active in systematizing, visualizing, and illustrating principles with alternative sketches and diagrams. Further development of architect's methods for visualizing the social sides is needed. It is an important task for the

shipowners to clarify what a program should contain and to update it when required.

Phase 2, Designing: Designing and working out a total solution of a "24-hour community" requires, perhaps, more art than science. Nevertheless, the architect should not overlook the guiding principles related to transport, traffic, and human contact.

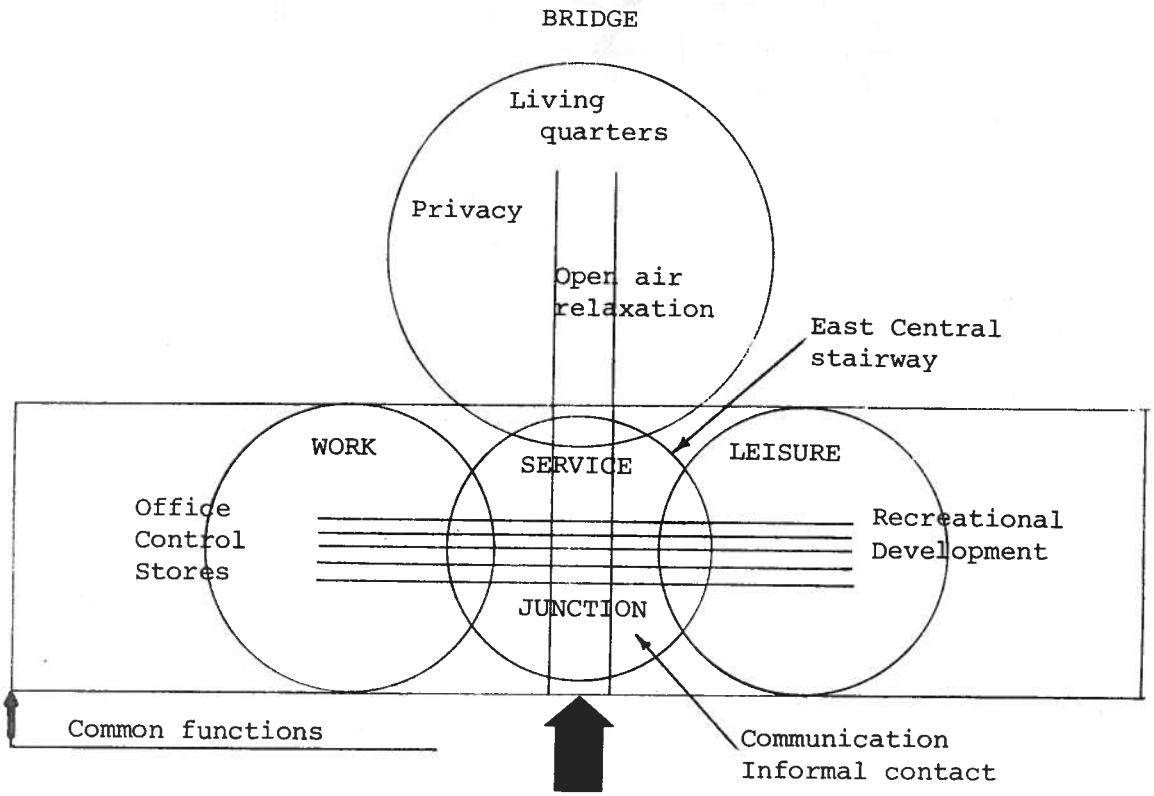


Figure 19. Initial schematic of the future ship.

From a main idea of superstructure area distribution, a conscious distinction between the functions for work, privacy, and recreation must be made. The design of a structure must always be based on a main idea. This also simplifies decision making in each phase of the building process.

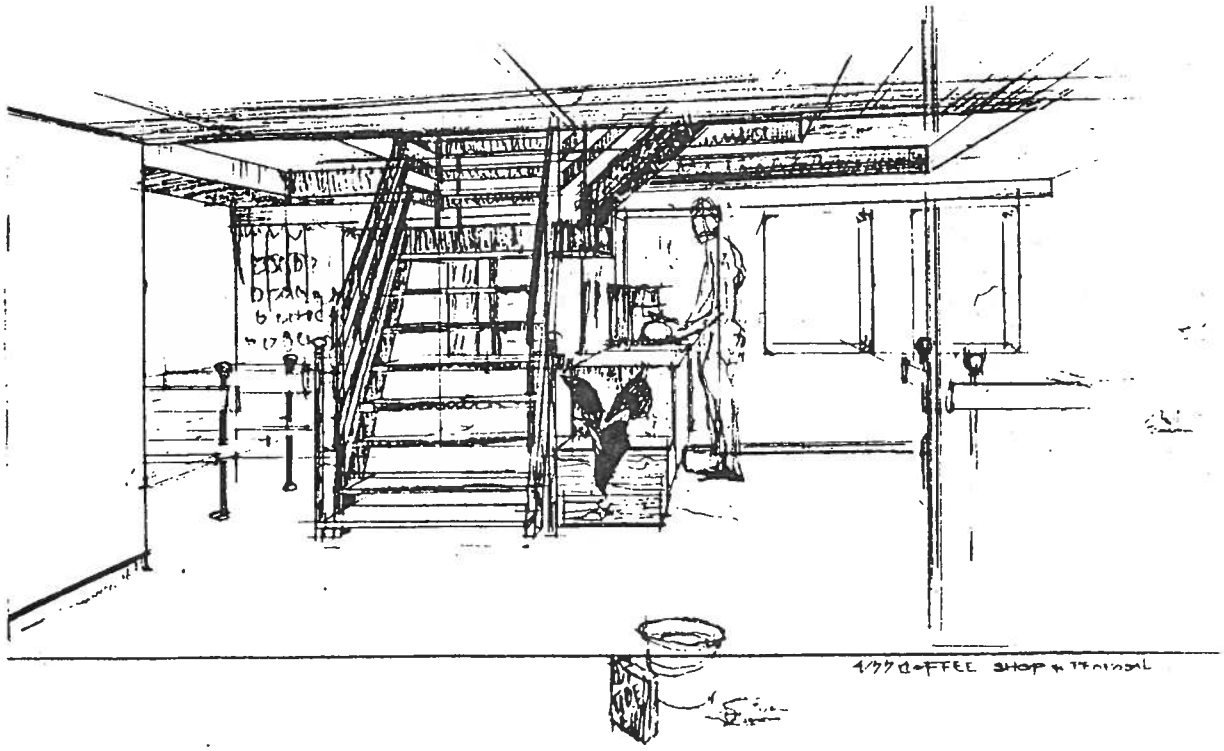


Figure 20. Air and space

In designing a smaller area, working with transverse sections as well as plan views is necessary. One has to work more "three-dimensional" with "feelings" for air and space. In the past sections and perspectives were seldom seen among the ship's drawings. This should change in the future.

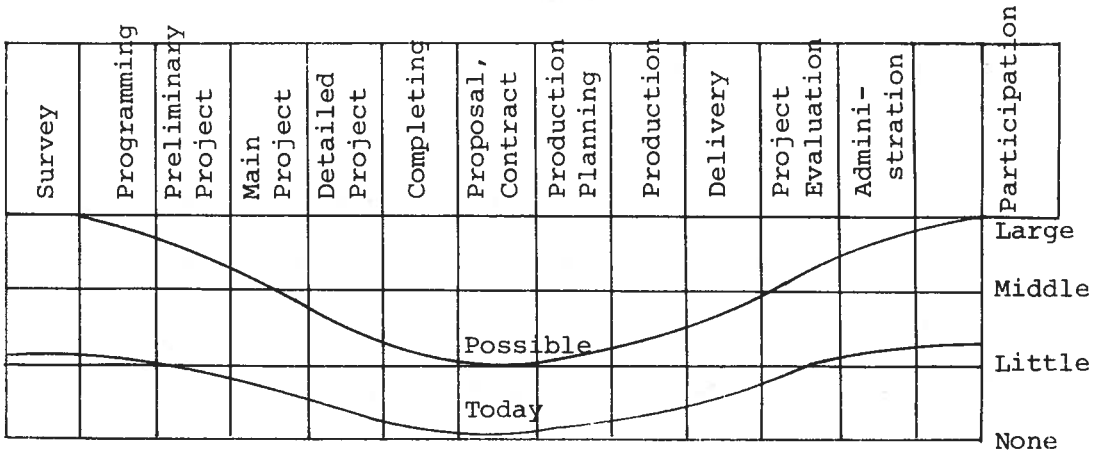


Figure 21. Possibilities of participation

(from Brantenberg, 1974)

Sailing personnel have actually been presented finished drawings, sometimes in abundance, but this has scant effect, because major changes at this stage are time-consuming and expensive.

In the accommodations of the ship of the future, space and size decisions must strongly reflect the living and working functions, and the number of personnel they are meant to serve. Current government regulations tend to concentrate exclusively on minimum permissible areas and numbers of rooms. This often inhibits the development of superior designs.

Where outmoded government regulations stand in the way of rational improvement, shipowners must take the lead in bringing about new laws and regulations.

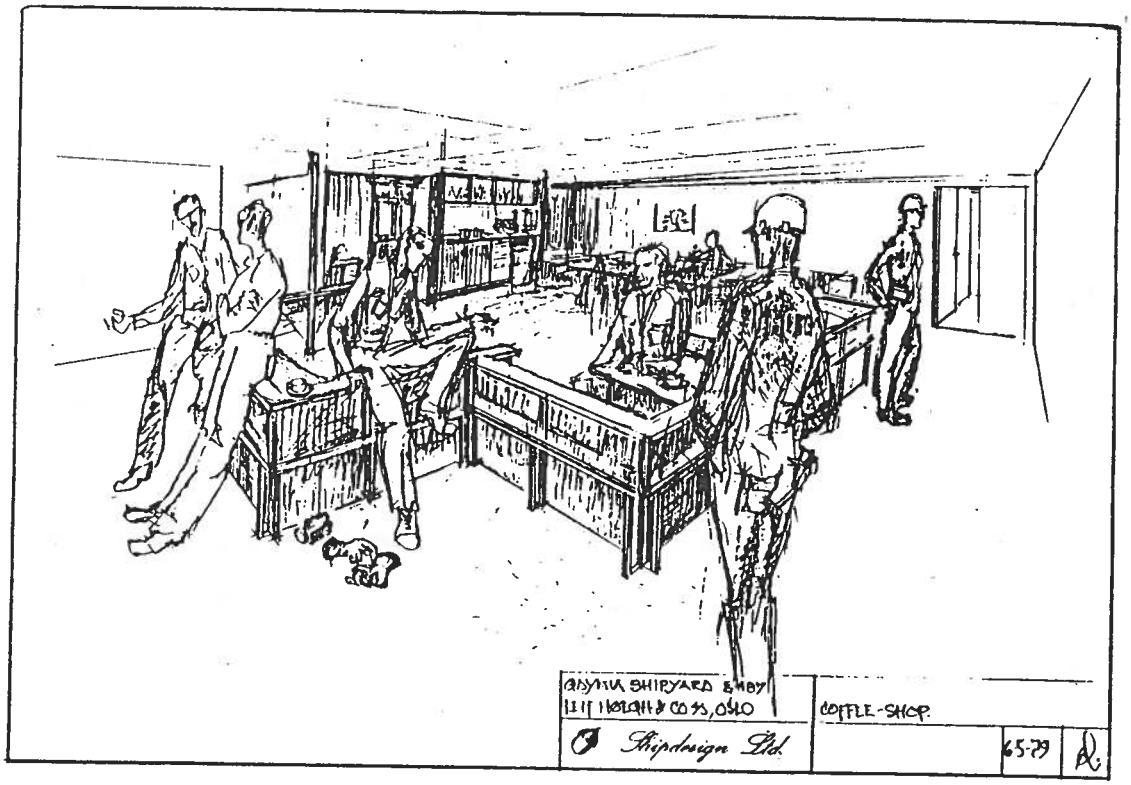


Figure 21. Informal contact

Phase 3, Contracting: Several shipowners have their own requirements for superstructure design and standards. In spite of the extra expenses many companies alter their superstructure on board existing ships and ships under construction in a series so as to improve social conditions on board.

Phase 4, Production: During a buyer's market, shipowners have a greater chance of realizing their needs and ideas as to what a superstructure should be. This chance can be further enhanced if the shipowners, through their trade associations, present a united front in advancing their wishes to the shipyards' trade associations. In Norway, for example, NSFI cooperates with ten Norwegian shipbuilders in finding alternative building methods. The shipowners should clarify the possibilities and constraints relevant to the alternative building method the builders choose to develop.

Owing to the nature of the sister industries, shipowners and shipbuilders should not be solving their design problems separately, but in harmony.

Ideally, a shipbuilding contract should allow a shipowner to work closely with the shipyard in developing the first two phases of the building process (i.e., programming, and design) as they apply to the accommodations and working spaces. Some shipowners lack the staff for such an approach, but several companies in cooperation based on common main principles should be able to attain this. Within the main principles there is always room for alternative solutions, covering the needs and wishes of the individual shipowner.

Phase 5, Experience: The benefits of experience are best exploited if some method can be developed to feed useful findings back into the design process. This includes information on the social aspects of accommodations.

OWNER COOPERATION

The differences from owner to owner are not so deep-rooted as to exclude cooperation. The main principles that emerge may be used as a basis for designs as well as negotiations with authorities and builders. It may also be that the time is right for discussing the standards authorities use when approving superstructures.

At the superstructure seminar in 1979 it was asked whether improved cooperation between owners would result in a standard based on new directions. It was answered that from common main principles there is a greater possibility for cooperation on ship superstructure design.

A closer cooperation between owners will require a more readily defined policy in each company and common definitions for a number of expressions repeatedly used by the shipowners:

- Further development of organization forms
- "Team sailing"
- Cooperative "environment"
- Specially designed ships with labor-saving equipment
- Easily maintained accommodation, etc.

In a cooperation a conscious use of a building process will be of substantial help. The division in phases clarifies where there are problems in the process and where there are possibilities of cooperation.

LITERATURE

1. Aure, Arne, En studie av arbeidsforhold og trivsel om bord i M/S Blix, NORCOL, 1975.
2. Acking, Carl-Axel, Fartygsarkitektur Allmänna synspunkter ock fartysgsinteriör, Lunds Universitet, 1977.
3. Brantenberg, tor og Mjøset, Bruker og bolig. Om påvirkning og medvirkning i praksis, NORCEM-seminaret Bygg Reis Deg, 1974.
4. Hall, Edward T., The hidden dimension. An anthropologist examines man's use of space in public and in private, New York, 1966.
5. Hetle, Aslaug, M/S ALTNES. Vurdering av prøvedriftsperioden i samarbeid med skipets besetning. AI-dok 19/79. Arbeidsforsknings-instituttene, Oslo, 1979.
6. Hetle, Aslaug, Rapport fra skipskonferansen M/S ALTNES. AI-dok 39/78. Arbeidsforskningsinstituttene, Oslo, 1978.
7. Hetle, Aslaug, Rapport fra Croftholmens forsøkskurs for skipsmekanikere. AI-dok 47/75. Arbeidsforskningsinstituttene, Oslo, 1975.
8. Herbst, P.G., Sosio-tekniske og psykodynamiske variabler innen planleggingen av en skipsorganisasjon. Tidsskrift for samfunnsforskning (Bd. 10 s. 371-400), 1969.
9. Johansen, Ragnar, Sjøfolk i utvikling. AI-dok 27/73. Arbeidsfor-skningsinstituttene, Oslo, 1973.
10. Johansen, Ragnar, Driftsformer til sjøs og samfunnsutvikling. AI-dok 42/74, Arbeidsforskningsinstituttene, Oslo, 1974.
11. Johansen, Ragnar, Planlegging av arbeid om bord i Balao. AI-dok 5/76. Arbeidsforskningsinstituttene, Oslo, 1976.
12. Johansen, Ragnar, Opplaering om bord i M/S Balao. AI-dok 17/76. Arbeidsforskningsinstituttene, Oslo, 1976.

13. Korbøl, Aud, Kvinner om bord. En sosiologisk undersøkelse av kvinners liv og arbeid om bord på skip i den norske handelsflåten. Institutt for sosiologi, Universitetet i Oslo, 1970.

14. Küller, Rikard, Fartygsmiljöns aktiveringsgrad - en omgivnings psykologisk analys, Tekniska Högskolan i Lund, 1978.

15. NR/SAF Felleskontoret, Skipsoverbygning - Prosjektstudie Ved: siv.ing. Per Klem, ark. Siri Schjetlein, 1972.

16. NR/SAF Felleskontoret, Skipsoverbygning - om planlegging Ved: siv.ing. Per Klem, ark. Siri Schjetlein, 1972.

17. NR/SAF Felleskontoret, Drift av Skip - Desentralisering som organisasjonsprinsipp. Ved: Halfdan Duckert og Rolf Kevin, 1975.

18. NSFI - Geir B. Kverneland, John G. Noreide, Geir I. Wattø, Bjørn Baggerud, Automatisering av arbeidsprosesser innen skipsbyggerier. R-85.79., Rapport-del II C, 1979.

19. Pena, William M. and Focke, John W., Problem seeking. CRS. investigation No. 18, Caudill Rowlett Scott, Houston, New York, Hartford, 1969.

20. Pfaff, Else, Pikenes arbeidssituasjon til sjøs. AI-dok 25/76. Arbeidsforskningsinstituttene, Oslo, 1976.

21. Roggema, J., "Høegh Mistral" prosjektet, en oppsummering etter et års drift. AI-S dok 1971 nr. 55, Arbeidsforskningsinstituttene, Oslo, 1971.

22. Roggema, J. og Thorsrud, E., Et skip i utvikling, Tanum, Oslo, 1974.

23. Rogne, Karl, Redesigning the design process: Superstrutures of ships, Applied Ergonomics 1974, 5.4, 213-218, 1974.

24. Rogne, Karl, Utdannelse, skipsorganisasjon og design av skip. AI-dok 43/73. Arbedsforskningsinstituttene, Oslo, 1973.

25. Rogne, Karl, Case: Product-Carrier. AI-dok 15/73, Arbeidsforskningsinstituttene, Oslo, 1973.

26. Rogne, Karl, Improving the quality of working life at sea, Workshop 1977. Restricted. AI-dok 13/77, Arbeidsforsknings-instituttene, Oslo, 1977.

27. Sealife, Sealife Programme. Design workshops superstructure, 17-18 Busy Street, London EC3A 5AH, 1979.

28. Schjetlein, Siri, Overbygget på skip som uttrykk for er nytt syn på arbeidsmiljø til sjøs, AI-dok 31/78, Arbeidsforsknings-instituttene, Oslo, 1978.

29. S.D.S., System for drift av skip, Delrapport 19 og 24, Forsker Karl Rogne, siv.ing. Per Klem, arkitekt Siri Schjetlein, 1976.

30. S.M.S., Skip møter Skip rapporter fra 1975-1979.

31. Steele, F.I., Physical Settings and Organizational Development, Addison-Wesley Publishing Company, 1973.

32. Svensk Skeppsforskning, De ombordanställdas arbeidsförhallånden och trivsel, Rapport nr 86, 1972.

33. Thorsrud, Einar, Skipet i utvikling, Arbeidsforskningsinstituttene, Oslo, 1967.

34. Vickhoff, B., Olika Miljöfaktorers samband med Trivselen på Svenska Handelsfartyg, Trebetygsuppsats i psykologi, Göteborgs Universitet, 1973.

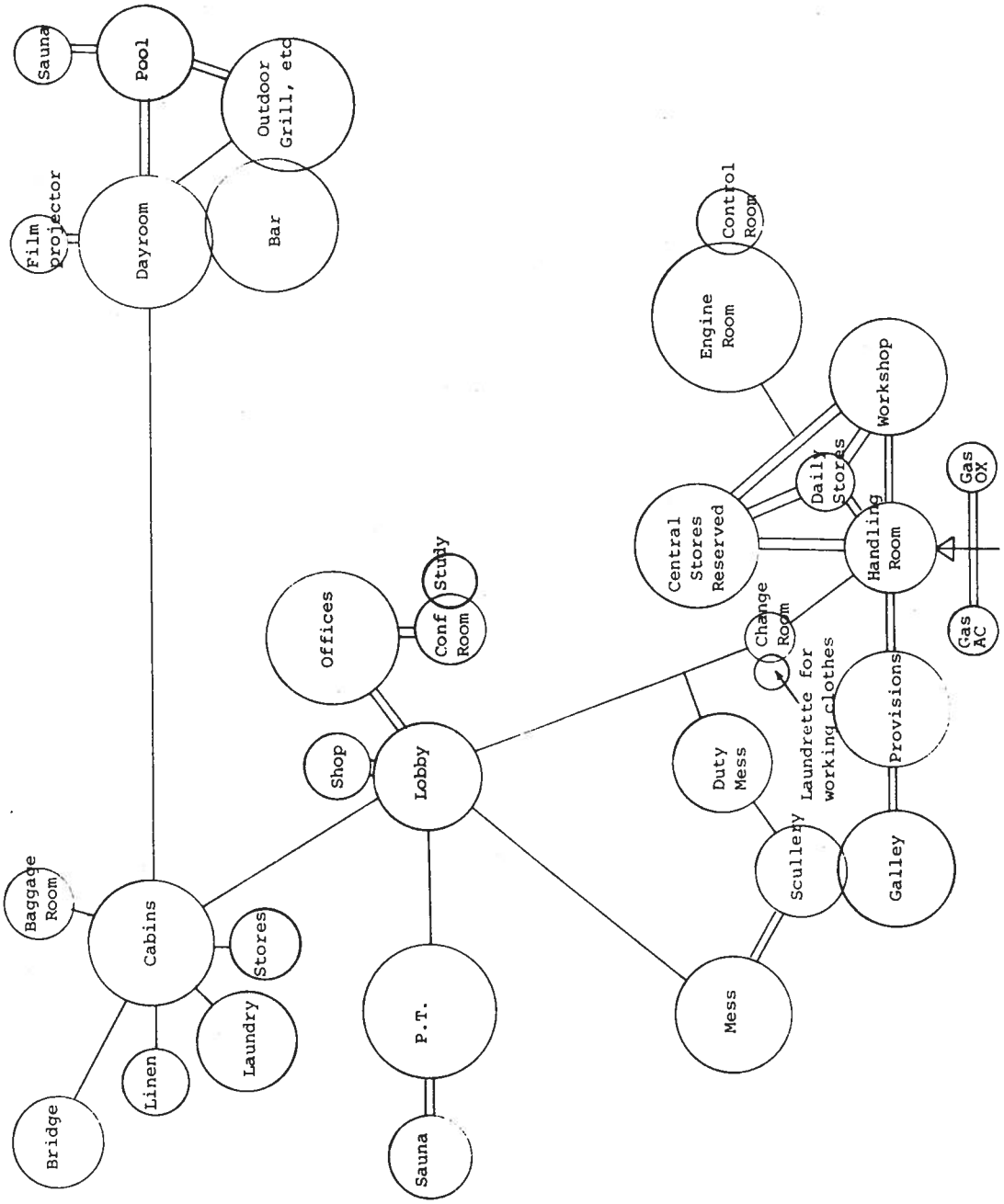
35. Weiler & Castle, The need for an Open System's Approach to Naval Ship Habitability Design, The Society of Naval Architects and Marine Engineers, 1972.

36. Østby, Harald, Automasjon i maskinrommet - organisatoriske og sosiale konsekvenser, AI-dok 69/74, Arbeidsforskningsinstituttene, Oslo, 1974.

37. Østby, Harald, Sikkerhet i arbeid og fritid, Sosiale forhold i skips-miljøet og sikkerhet til sjøs, AI-dok 23/76, Arbeidsforsknings-instituttene, Oslo, 1976.

38. Aamot, Solveig, Kapteinens dilemma, AI-dok 5/74, Arbeidsforsknings-instituttene, Oslo, 1974.

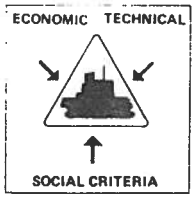
APPENDIX: Contact Diagram



SUPERSTRUCTURES OF SHIPS.

HUMAN ENVIRONMENT ON BOARD.

"PLANNING A COMMUNITY".



DEVELOPMENT – CHANGES IN SOCIETY.

Architectural programming:
Must be based on social as well as technical and economic criteria and users' influence.
Capacity to accommodate later developments is vital.
A new approach to ship design:
Cooperative working!

THE SHIP OF THE 1960'S:

Technical developments - the changes that were made were not tried out as part of a total system.
Manpower problems necessitated: Higher salary, better social and living conditions on board.

THE DEMANDS OF THE 1970'S:

Changes in the technological, social and economic conditions in shipping, demands for a work environment.

"24 HOURS' COMMUNITY".

Officers and crew have their work, their leisure and their private life on board.
They need not only a work environment, but planning of their total environment on board.
There is need for a natural change between work and leisure, private life and social life.

ARCITECTURAL POSSIBILITIES:

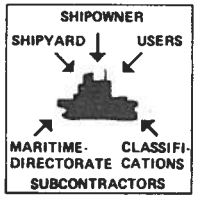
Through planning seek to divide the superstructure into coordinated areas:

THE WORK AREA,

LEISURE AREA,

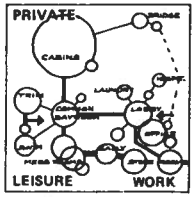
PRIVATE AREA,

The principle of functional rather than status divisions.
The communications on board must be straightened out, both traffic, transport and the contact between the human beings on board.



PARTICIPANTS AT THE PROGRAMMING STAGE:

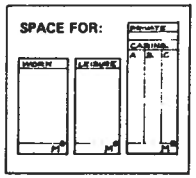
The shipping company,
the users,
the shipyard,
maritime directorate,
classifications society,
subcontractors.



SCHEMATIC PROGRAMMING.

Communication network:
Information about transport, traffic and social integration or separation.
A "layout" of policy.
"Soft data".

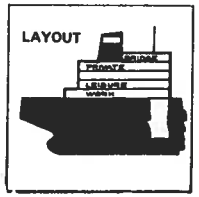
Information not solutions.



DETAIL PROGRAMMING:

Functional program and its space requirements.

Framework for decison making.
Function and organization stated abstractly, not to inhibit design alternatives.



LAYOUT BASED ON A "MAJOR IDEA" FOR THE SHIP AS A "24 HOUR COMMUNITY".

The total area divided into 3 parts: Work area,
common leisure area,
private areas.
Functional rather than status divisions of social space.

Crew cabins
24 men, 2 in each of 7m²
4 toilets
4 handbasins

2 messrooms
Sailor and engine crew respectively.
Fixed table and benches.

Cabins for officers and engineers.
Cooks and cadets.

Office in the cabin.

3 messrooms
Galley

Meeting place

for recreation rooms.
levels of accommodation.

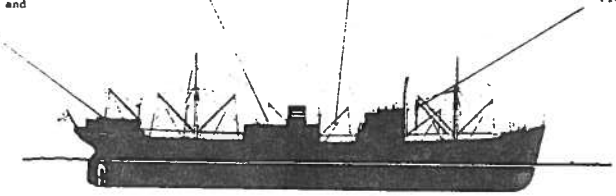
Sharp distinction both in work and social life.

Bridge

The captain's accommodation:
Bedroom, bath, saloon and office.
Cabins for 12 passengers.
Steward's cabin.

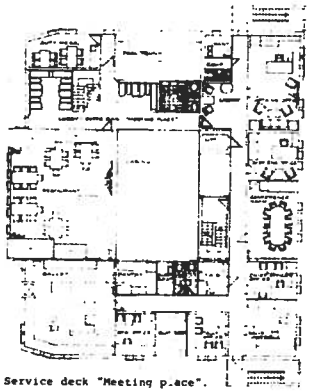
Dining saloon with special chairs.

Provision store.

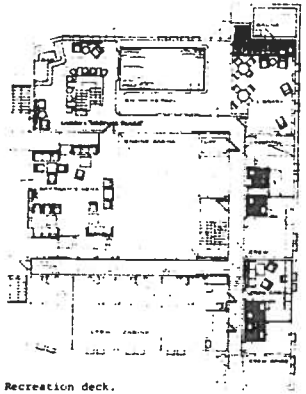


THE "OLD" SHIP:

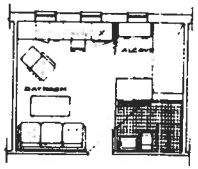
An expression of the experiences and social ideas of its time.
Heavy to run - based on cheap labour.



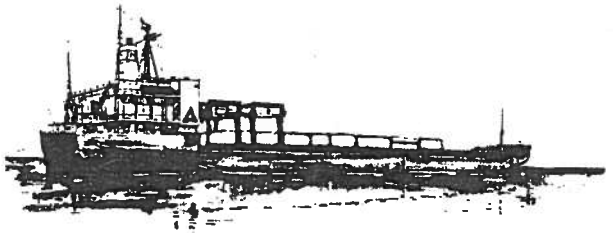
Service deck "Meeting place".



Recreation deck.



Crew cabin.



THE SHIP OF TODAY.

NORWAY.

386 308 km.
4 mill. pople.
37 000 seamen in foreign trade.
Monarchy.
Democracy.

SHIPPING

International sea transport, one of the major industries.

SHIPS.

Cruise, cargo liners, tankers, bulkships,gas, container-vessels, supply ships etc.

Specialized shipping.

THE NORWEGIAN SHIP RESEARCH PROJECT NO. 24, 1970 – 1975.

Led by:
Naval engineer: Per Klem
Social scientist: Karl Rogne
Architect: Siri Schjetlein

ARCHITECT: SIRI SCHJETLEIN