Developing Capabilities for Managing Global Industrial Projects

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Business performance in many industrial companies relies on capabilities to manage international projects. In this chapter the primary focus is on how Nordic Maritime Services (NMS) in Norway has built up its capabilities for managing global oil-tanker construction projects. In the case, the authors describe how NMS in Norway, collaborates virtually with the Swedish company Inmotion, to develop a system that can help to manage NMS's growing portfolio of oil-tanker construction projects in Southeast Asia, for their clients in the Middle East. The chapter offers insights into 1) the work of NMS in managing oil-tanker construction projects, and 2) the work aimed to improve the capabilities to manage the projects. We conclude the chapter with a model describing how a company can provide complex industrial solutions to customers by managing a network of actors working with product development and production.

Integrator – Providing Industrial Solutions

Many industrial organizations have faced increasing demands to supply "turn key" solutions. That is, the customer wants to solve a problem by purchasing an industrial system or solution from one source. In most cases the supplier needs to coordinate several subcontractors in order to deliver. Generally, both stakes and risks are high in these projects.

In this chapter, the focus is on the strategy aimed to become the integrator in the industrial network. With this role, the company controls the work of creating new products and services, but makes use of resources, processes and capabilities of other organizations in core processes. Performance of the supply chain serving the customer is critical (cf. Lambert & Cooper, 2000).

As an integrator of industrial systems, it is tempting to sell complex solutions expensively, and purchase resources for its production at low costs. Rather than developing and producing all the parts, the integrator works with managing product development and production which is performed by other organizations. Complexity is high because the solution is dependent on integration of product development and production.

The path towards an integrator role can be described in terms of a “ladder”. Companies that are strong in production (1) can develop capabilities within product development (2). Companies that are strong in product development (2) can develop capabilities in managing product development and production (3).

It is difficult to be good at product development without knowledge of production. However, with production knowledge, it is possible to be a qualified buyer of production services. If production is outsourced, the direct feedback is lost, which over time leads to a deterioration of production knowledge. There is therefore an important dynamic between the levels. An integrator must over time accumulate feedback to stay in touch. It is the whole of the three levels that is the key to be successful.

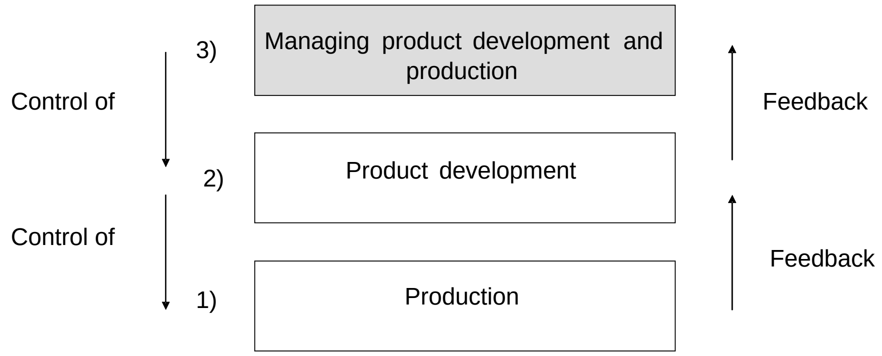

Figure 1. Levels of capabilities relevant for integrators of industrial systems.

An integrator typically needs to coordinate work performed in different organizations. The geographic distances and the quantity of information managed during a project makes it important to work systematically. Work methods and information systems become key parts of the business infrastructure (cf. Bannen, 1998).

In this chapter, the focus is on the level “managing product development and production”. To succeed with achieving strategic advantage on this level, firms must have strategic insight and capabilities for improvement in order to establish processes and information systems for managing complex product development and production projects (Andersson, 2005).

Capabilities based on processes are critical to compete (cf. Stalk, Evans & Schulman, 1992). The challenges of building integrator capabilities are here exemplified with a case from the shipping industry. How are global oil-tanker construction projects managed? We will look into Nordic Maritime Services (NMS, www.nordic-maritime.no) in Norway. Further analysis related to this case is available in Andersson & Edwards, 2006.

In a “typical” example, the buyer of an oil tanker is situated in Iran, the shipyard building the vessel is in South Korea, and major ship components are constructed in Europe and China. The job of Nordic Maritime Services (NMS) as a representative of the buyer is to oversee the project so the buyer and user (operator or charterer) of the ship get a cost effective vessel which adheres to the contract and all international quality and security standards.

NMS exerts control of, and integrates, resources in the industrial network building the ships. They approve design, monitor progress, select suppliers, observe and report non-compliance and inspect quality. What are the critical processes involved in directing these giant projects? In this case we will get a glimpse of how NMS built up its project management capabilities.

When we look into the NMS case, we will see the importance of the improvement processes in which the operative capabilities are established. In the case, the Swedish company Inmotion (www.inmotion-software.com) provided consultancy and developed the project management systems for NMS without any personal meetings between Inmotion and NMS. Such “virtual”, or “offshore” system development projects, may reduce the cost for improvements, and provide access to resources and capabilities beyond the normal reach of the company.

The oil-tanker construction projects, and the virtual improvement project described in the chapter, are concrete evidence that it is possible to work with complex projects across distances. This possibility provides both opportunities and threats for domestic companies.

The authors of this chapter have both worked for NMS in different ways. Ian Edwards has been an employee of NMS, and now works for Det Norske Veritas (DNV, www.dnv.no). Martin Andersson works as a researcher at SSE and is co-founder of Inmotion. In this case, Martin Andersson worked with Ian Edwards in the improvement project described in the chapter. The research method used has been clinical research (Schein, 1987). In this approach, the researcher takes a helping role in relationship to the client, in order to understand the problems in the organization.

The purpose of the chapter is to inspire reflection regarding development of capabilities for managing global projects. To develop such capabilities are key for companies striving to work in a global economy. The NMS case can provide inspiration for other organizations struggling to integrate and manage complex projects on a global scale.

The Role of NMS in Global Oil-Tanker Construction Projects

NMS has an interesting role in the shipbuilding network. They have large international customers (ship owners), for whom they take on the responsibility to supervise and to a certain extent control gigantic projects. They specify requirements on the vessel being developed, and supervise and coordinate the many actors involved in the construction process.

In general terms, the job of NMS in the role of ship consultant is to verify in a cost effective way that a ship is designed and built in accordance with the contract, specification, rules and regulations, buyer's operational requirements and good shipbuilding standards. A shipyard is selected to build the ship, using selected sub-contractors (makers). The ship is approved and classified by a classification society. The ship owner often has a charter agreement with a charterer that operates the ship. The main actors and relationships are shown schematically in Figure 1.

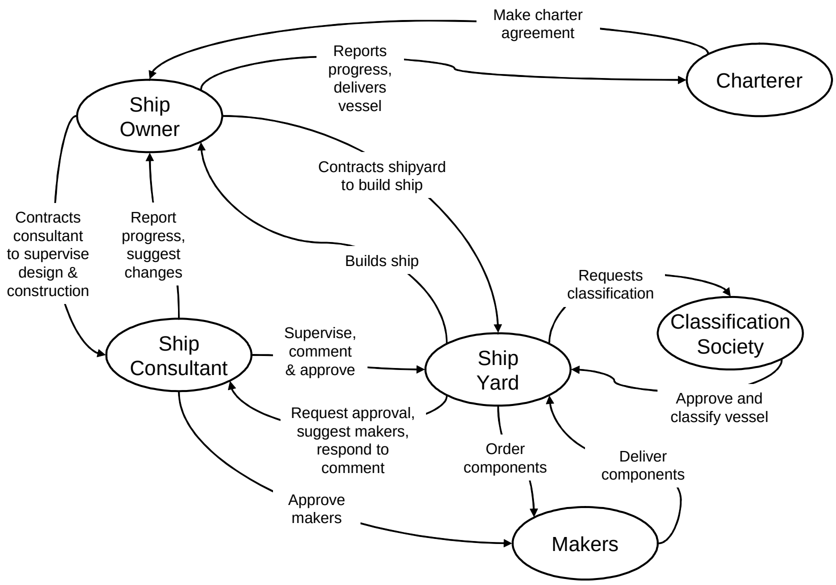

Figure 2. Schematic illustration of business network for shipbuilding projects. NMS has the role of ship consultant, working on behalf of the ship owner to control the project.

The complex business network for oil-tanker construction is even more complex when we consider that NMS in the role of ship consultant help several ship owners at the same time. The ships can be built by different shipyards, and in turn rely on different makers. NMS needs to manage a portfolio of global oil-tanker construction projects.

The task requires that people at NMS have a high level of technical expertise and a high level of project management expertise, as well as a high level of cross-cultural management skills.

A "Typical" Project at NMS

Shipbuilding projects are generally carried out at a very rapid pace. For example, a typical oil tanker can be built in only seven months. The consequences of mistakes during the project can be considerable, for example in terms of cost, delivery time and security. The buyer (ship owner) therefore needs a method to effectively verify that each step of the shipbuilding process is of high quality.

NMS usually divide tanker projects into four phases after the shipbuilding contract has been signed between the buyer and the shipyard (see Figure 2).

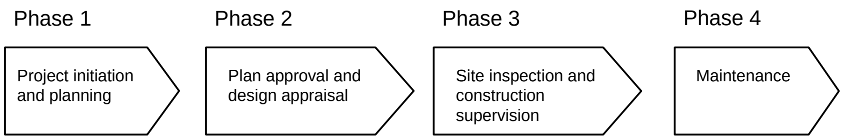

Figure 3. NMS project phases in oil-tanker construction.

Phase 1: Project Initiation and Planning

In the project initiation and planning phase the main actors in the shipbuilding project meet to establish lines of communication and procedures to be followed and hold what is referred to as a "kick-off meeting". The shipyard typically suggests an initial design based on the shipbuilding contract and proposes sub-suppliers for various major components. The buyer of the ship suggests changes. The shipyard then provides drawings to NMS and the Classification Society for approval. The ship design consists of hundreds of drawings of the ship.

Phase 2: Plan Approval and Design Appraisal

In the plan approval and design appraisal phase, each drawing is reviewed and commented upon by NMS staff. The comments lead to clarifications, arguments or changes in the drawings. A new version of the drawing is then created, and NMS staff close comments after they have been incorporated in the drawings. Alternatively, comments may not be reflected in the revised drawings, in which case NMS staff at the shipyard must verify during construction that such adjustments are actually built into the ship.

Drawings often need to be approved from different perspectives. A naval architect may need to comment on the strength of hull structure and an electrical engineer may need to provide input about how electrical systems are built up. Drawings are typically sent as paper copies or electronic CAD files whilst correspondence channels include e-mail, fax or regular mail. NMS send drawing approval reports to the ship owner and shipyard with requests for changes. The shipyard replies with comments on the comments.

With hundreds of drawings there may be thousands of design change requests. NMS staff supervises several projects and ships at the same time. The quantity of the information managed during the design approval phase makes it critical to have processes and systems that can manage design approval cases systematically with high quality. The drawing approval is divided into areas related to the ship (hull, outfitting, basic design, piping, accommodation, machinery, electrical).

In the Plan Approval and Design Appraisal phase, the suppliers suggested by the yard are evaluated by NMS. They typically evaluate three suppliers for each main component and select the one that best matches the buyer's needs. During the design appraisal there are typically changes compared to the shipbuilding contract. Each change is tracked and approved. It is particularly important to track the cost impact, and impacts on the ship deadweight (cargo carrying capacity).

Phase 3: Site Inspection and Construction Supervision

After the plan approval and design appraisal phase, the drawings form the basis for building the ship. Site inspection and construction supervision involve inspections and non-compliance reports to highlight any deviations from the drawings. Is the hull of the correct material and thickness? Are the structural changes agreed during Phase 2 actually carried out? Have the life rafts been moved to simplify their use? Is the paint of the right quality and thickness? It is critical that all information about design requirements and changes are in order. If not, there is no basis for evaluating the way the ship is actually built. An NMS site team supervises the daily operations during the actual building of the ship at the yard. Information about progress needs to be communicated from the local NMS site team to the central NMS office and the ship owner.

Figure 4. Example of tanker built under supervision of NMS at Hyundai Mipo Dockyard, Korea.

Phase 4: Maintenance

Since NMS has a record of all drawings used in the construction, and information about suppliers, they also participate in the maintenance phase. For example, they help when parts are replaced, and when the ship owner makes warranty claims. It is then crucial to have a record of all requirements put forward by NMS on behalf of the buyer and the commitments made by the yard.

Re-use of Information and Knowledge

In many cases several ships are based on the same drawings. Several hulls are built when the design is frozen. In these projects the complexity is reduced since the design is already approved. In this case the information and knowledge created is used to build the additional vessels.

Frequently, NMS's engagement on one project may lead to the establishment of a relationship with a new client who may request services for a similar ship to be built either at the same shipyard or elsewhere. NMS have a competitive advantage in such case through the accumulated knowledge and experience from previous projects. In fact, such knowledge and experience is the key in acquiring the new relationship. The re-use of information and knowledge acquired from previous projects is therefore highly critical and becomes a key capability of the business.

Strategic Business Challenges for NMS

In 2004, NMS foresaw a period of growth in their business. The market for oil tankers was expanding. They realized that countries with less developed skills in designing and building oil tankers would make key parts of the construction. Their analysis showed that they needed to be able to work virtually to support work in nations with low labor costs but not the same tradition of shipbuilding as European ship builders had. To be able to support their customers, NMS needed to be strong in managing projects involving actors in the Middle East and Southeast Asia. In other words, it was clear that the growth of the business would require them to have capabilities for managing a portfolio of global projects.

Even though NMS staff had knowledge of the processes involved in the projects, the information systems supporting the projects were increasingly becoming a problem. NMS relied primarily on a business system developed in Microsoft Excel for managing the operative information during the projects. Drawing approval, client reporting, sub-supplier selection, non-compliance, etc was managed in an elaborate set of Excel files. This was problematic for several reasons.

The information managed needed to be traceable since it was used in several project phases. For example in Phase 1, the shipyard would propose a maker of the rudder. NMS would evaluate the maker and propose a new one in case it was not acceptable with respect to contract and operational requirements. In Phase 2, the shipyard would submit drawings of the rudder. NMS would evaluate in more detail, for example that design is calculated based on correct operation conditions and interfacing equipment is appropriately integrated. There could be many revisions of the drawing in order to incorporate changes suggested by NMS. In Phase 3, NMS would inspect that the installation of the rudder was made according to final drawings, and the rudder would be tested in sea trials to evaluate performance against both specifications and operational requirements. This relational property of the managed information was very difficult to manage in spreadsheet form, particularly when considering the complexities of the whole project portfolio.

When the ships were in the construction phase, changes needed to be made to the files in Norway as well as in the local shipyard. It was difficult to keep track of the different file versions and changes. The fact that the project information was spread into several files led to a project reporting process that was complex. Manual work was required to summarize the plan approval status, non-compliance reports and selected suppliers. The administrative work of managing operative project information became both complex and costly.

The complex relationships between the files were difficult to learn. This was especially problematic since NMS was hiring new staff. It was important that new staff quickly became productive and that the consistency of the data was safeguarded.

Another problem was that it was difficult to collect information about resources used in the projects, and accumulated project cost. This made internal project control difficult.

In Norway, human resources are scarce and costly, and the growth of the business depended upon hiring additional manpower and developing systems to optimize processes and reduce time spent by staff performing tasks. NMS needed to be able to support growth in their business to create economies of scale and contribute to a more profitable enterprise, whilst the resources available for the implementation of IT solutions were very limited.

Opportunity	Market is expected to expand with activity in the Middle East and Southeast Asia.
Threat	Companies from Southeast Asia may increasingly compete with NMS.
Strength	NMS has relevant resources in terms of skills and work processes to meet the needs of the growing market.
Weakness	Information systems resources at NMS hinder growth and do not support effective management of global projects.
Challenge	NMS must develop capabilities to manage global projects.

Table 1. Summary of situation at NMS.

The spreadsheet solution that had served the company well was now hindering its business strategy. The growing company required capabilities for managing complex information structures on a global scale, in dozens of oil-tanker construction projects.

Thus, it became a strategic challenge for NMS to develop capabilities to manage global projects. They had a fairly good grip on the processes that were required, but they did not have the required information systems to execute the processes in global projects.

The specific challenge was to acquire the information technology required to improve their capabilities for managing global projects. They needed a matching combination of skills, processes and information systems to take the business to the next level.

Developing Capabilities for Managing Global Projects

The strategic challenges for NMS, as described above, led to discussions about how to perform the improvements. Ian Edwards (one of the authors of this chapter) who then worked at NMS, started to look for ways to enable the expected growth of the company and improve capabilities for executing global projects. He quickly found that general project-management solutions were not sufficiently qualified to support their specific processes. There existed tailor made solutions for solving some of the problems, but these did not fit with the kind of work processes used by NMS. Further, the systems were too expensive and built up of proprietary software, making it difficult to adapt the system to NMS requirements.

It was very important that the solution supported existing established work processes that NMS had been successful through, rather than having to change the work processes to fit with a particular system.

He ended up buying a system called ProjectCompanion, a standard solution for managing projects, and then started a project to implement and adapt the solution together with the Swedish system supplier, Inmotion. Martin Andersson (one of the authors of this chapter) acted as project manager at Inmotion. The local installation of the system was moved to a server maintained by Inmotion to facilitate iterative system upgrades.

During a period of four months, NMS and Inmotion collaborated on process descriptions, screenshots, prototypes and data models as the extended project-management system evolved. The work was carried out using e-mail, Internet telephony, chat, etc. No personal meetings were held during the project.

Martin Andersson, the project manager at Inmotion, interviewed Ian Edwards at NMS about their processes and information requirements, and then translated it to a specification for extending the standard product used.

Ian Edwards discussed the solutions with the people at NMS, and suggested modifications. The prototype solutions were then implemented, tested, and upgraded in the live installation used by NMS.

In some cases, the lead times from idea to live use of a function could be as little as four hours. Through the short lead times in development, new system functions could be used in NMS projects quickly, and feedback for enhancements could be collected. Through the use of standard components, NMS could also make modifications to existing report formats.

The iterative system development work led to high involvement of the users during the development process. This simplified the implementation of the system in the organization. It was increasingly accepted at NMS.

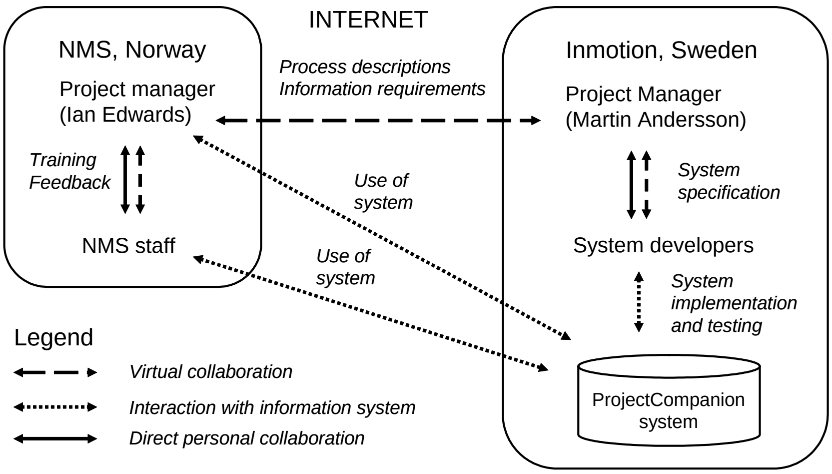

Figure 5. Schematic illustration of improvement resources and processes. The extended project-management system could be implemented virtually because of effective communication within and between NMS and Inmotion.

The development work required NMS to think about the processes involved in detail. Processes were redesigned and optimized in order to be more effective. For example, by mapping out the drawing approval process, NMS were able to highlight potential quality issues and thereby introduce a new improved process. At the same time, a documented definition of the process proved to be valuable in providing information to new staff members during their introduction. In other words, the process descriptions were used both in designing the process and system, and in communicating the new working methods to NMS staff.

In the construction phases of the projects, it became clear that the available bandwidth for communication did not permit effective use of the system at the new site offices in Iran, South Korea and China. The Internet connections did not have enough capacity. Since NMS required flexibility in what parts of the world the ships were constructed, a project was started to develop an offline client for inspection work. With this system it was not necessary to have high quality communication links between the head office and the site offices.

In the analysis, it became clear that different ship yards have different work practices. For NMS, this means that they need to be able to supervise work perfomed regarless of the degree of structure in yard work. The low-cost advantages provided by the relatively new ship yards had a backdraw in terms of lacking experience. This led to an increasing focus on inspections for NMS. The importance of concrete quality control was evident.

Operative Processes and Systems for Managing Global Projects at NMS

Traditional work practices in the shipbuilding industry had formed a base for the processes and information systems that were implemented at NMS. However, they were customized to NMS's business network position. It supported their role as integrator of the projects on account of the customers buying the ships.

The most important parts of the project management system that was introduced at NMS are described in the table below.

Process / capability	*Description*
Plan and control projects	Plan project milestones and tasks. Control progress. Monitor time and cost related to budget.
Report progress to client	Summarize project status from client perspective.
Approve design	Review drawings to identify deviations from client requirements and shipbuilding standards. Control that requested changes are performed in drawings.
Select suppliers	Evaluate alternative suppliers. Summarize information about selected suppliers.
Manage design changes	Support the process of establishing design changes. Store information concerning changes and relevant impacts on the project such as cost, capacity or delivery time.
Inspect construction and resolve quality problems	Inspect ship with special focus on areas known to require special attention. Record results of inspections with actions for follow up activities.
Secure maintenance	Use information about suppliers and project history to support the resolution of maintenance issues.
Make warranty claims	Support the issuance and documentation of warranty claims.
Administrative processes (time reporting, expense approval, etc)	Centrally store all time and expense consumption to facilitate invoicing, and time and cost control. Enables re-use of information for planning and budgeting future projects.
Re-use information from previous projects	Provide access to the database for ship operators with an easily traceable history of all ship components to assist problem solving during operation phase.

Table 2. Description of processes and capabilities critical for managing global oil-tanker construction projects.

The system helped to optimize the work and improve quality of the work performed. For example the Excel based solution did not always help to highlight what was important or help NMS to prioritize tasks. The processes and tools introduced at NMS are essential in supervising the activities performed by the shipyard and makers. It provides possibilities to easily get an overview of outstanding issues, such as comments, non-compliances, outstanding correspondence, and follow up. These capabilities are key in controlling complex global projects. They are particularly critical in the design approval and construction phases, because large quantities of information are managed and the cost impacts of mistakes are large.

A key strategy of NMS is to transfer knowledge from previous projects and ships in operation to new projects. Prior to implementation this knowledge existed only within the minds of the staff involved and dispersed in different files. The searchable database gives quick and easy access to relevant data.

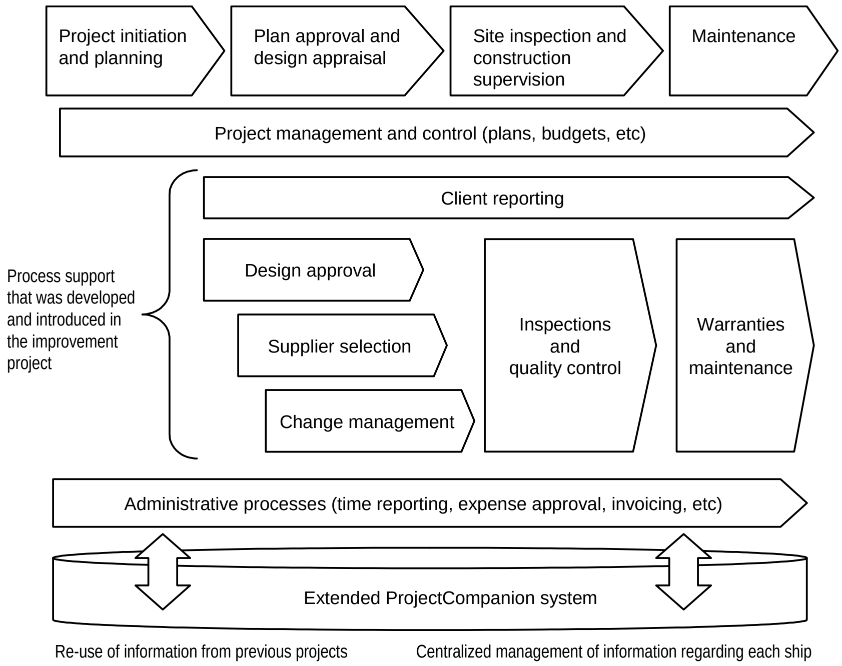

Figure 6. Schematic illustration of operative processes and information support used at oil-tanker construction projects at NMS.

The system provides traceability by implementing a system of class codes, which breaks the ship down into a hierarchy of sections and components. Using this classification, it is possible to easily find data relevant to a particular part of the ship. For example, by searching for components in an existing ship, the drawings, selected suppliers, and inspection results can all be available, and thus make it possible to support decisions on design alternatives and suppliers for future ships. This improves reporting routines to the buyer, integrates data across project phases, and assists in solving future problems during operation of the ship.

Implementation Results

The new processes and project management systems quickly became mission-critical for NMS. They became an integrated part of the operative and administrative processes in NMS.

One of the keys to the successful implementation was the involvement of NMS staff in the development process. Through their involvement in the development of functions and look and feel of the system, staff obtained a sense of ownership of the system. This contributed significantly in fostering enthusiasm and interest in the system and accelerating the adoption and integration in peoples' every day work.

Use of Processes and Systems

The extended ProjectCompanion system became the key system used during the oil-tanker construction projects. The list below summarizes the use of the new project management system in NMS during the first 18 months.

- 20000 workflow cases of drawing approval, design changes, supplier selection, inspections, etc were created. These workflow cases support and document the main part of the work performed during the projects.
- 8800 comments about the design, construction and quality of the ships were entered into the system. These comments were continually monitored and closed when requirements were integrated in drawings and construction.
- The comments were ordered in 1500 reports, which were sent to clients, shipyards and suppliers, summarizing requirements on design, suggesting suppliers and notifying them of "non-compliance" with contracts and regulations.

The new information systems resources were used in key processes. In the following, the impacts on capabilities and business performance will be summarized.

Improved Operative Capabilities and Business Results

The improvement project carried out made it possible for NMS to manage a considerable increase in its project portfolio effectively. In other words, it enabled growth, but also increased productivity. Further, it also made it easier to control the work performed with high accuracy and quality.

Improved Capability	*Business Results*
Capability to integrate and control work performed by shipyards and makers in different countries	Improved management of global projects
Capability to introduce new employees effectively and efficiently	Enabled business strategy of cost-efficient growth
Capabilities to control design, select makers, manage changes, control quality and maintain ships	Improved quality, increased safety and reduced running cost of ships, eventually leading to improved customer satisfaction.
Capability to re-use information from previous projects	Improved productivity
Capability to manage operative and administrative information effectively	Reduced costs, higher quality reports (improved customer satisfaction)
Capability to work with structured processes and integrated information systems	Established strategic advantage based on quality management system

Table 3. Improved capabilities and business results at NMS.

Some indications of the capabilities in terms of business results are shown in the list below.

- The new processes and systems enabled growth from 15 to 40 people at NMS. This increase in staff would have been difficult without structured processes and centralized information management in the projects.
- Four new offices were established (South Korea, Iran, China, Malaysia).
- The new capabilities supported an increase from managing 8 to managing 40 ship construction projects.
- NMS could highlight the system as a strategic advantage relative to their competitors.

Having structured work processes and supporting systems for project management, design approval, supplier selection, requirements delegation, change management, quality control and collaboration are critical to NMS's strategy of ensuring that ships are designed and built to the highest standards. It is very difficult to manage and control large projects without structured processes and information systems. In this sense the established capabilities form a central base for NMS in their business.

These business results could be achieved with a combination of well-structured business processes, supporting information systems and a successful implementation.

Implementation Challenges

When the new work methods and systems had been used for some months, it became clear that different project managers used the system in different ways. Not all project managers had the same understanding of how it could be used. Communicating new methods and tools was thus a challenge.

It also became clear that site offices in South East Asia and the Middle East had difficulties in using the system due to limited capacity in data communications. Since most of the inspection work at site offices needed to be performed off-line, it was a challenge to find a solution that was simple to use. Also, the process of communicating inspection results to the yard needed special attention.

Model for Industrial Integrators

In order to describe the work approach used by NMS in their projects we have created an empirically grounded model. The model is based on work performed at NMS, which in turn is influenced by traditions within the shipping industry. This model can be interesting for other companies who have the role as integrator of industrial solutions.

Client reporting and communication is shown at the top since helping the customer is the primary concern for NMS during the project. In order to manage the project a certain level of project planning and control is required.

The project is divided into general phases. Each phase ends with a major milestone. However, the bulk of the work is performed in operative processes. Each operative process has many executions during the project. For example there are many drawings to approve, many changes to manage and many parts of the ship to inspect.

Design approval and supplier selection continuously contribute to specifying the solution and who will be involved in its delivery. It is important to manage changes throughout the work.

The developed solution is verified through inspections. In cases the suppliers do not follow previous agreements, non compliance reports are issued and problems are resolved.

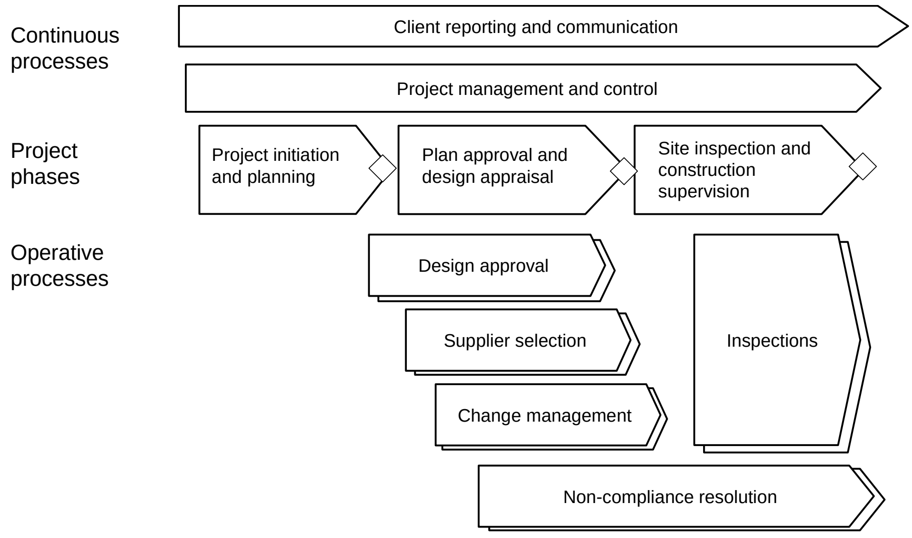

Figure 6. Model of capabilities relevant for integrators when developing complex industrial systems.

Although all parts of the model are relevant for integrators of industrial systems, we would like to highlight two processes we believe are critical. The first is design approval and the second is inspections. By making sure that the solution is specified in detail in accordance with client needs, and inspecting the actual results, it becomes possible to control the work performed by suppliers, and thereby reducing project risks. When there is little time available for developing the business, it may be a good idea to make sure that these two processes are performed with consistency and high quality.

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