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Analysis of Different Digital Solutions for Material Nesting in Steel Shipbuilding

Abstract

Within the shipbuilding process an efficient steel structure elements fabrication process represents a fundamental and important phase as it directly affects production efficiency, material utilization, and the quality of the finished ship structure. A key role in modern sheet metal cutting is played by the use of computer-aided digital solutions known as *nesting* software. Successful implementation of digital model with cutting in manufacturing process requires the involvement of highly qualified personnel – designers, CNC operators, and engineers with solid knowledge in digital technologies in coordination with manufacturing requirements and technical standards as well as the rules of classification societies. This technology enables automatic layout of elements, precise control of cutting processes, tracking of surplus material, and generation of NC programs for controlling CNC machines. In this context, the choice of software tool – such as Nestix for Cadmatic Hull or Aveva Marine nesting – has a direct impact on accuracy, speed, level of automation, and flexibility in the production process. Therefore, the selection of appropriate nesting software is not only a technical but also a strategic decision for every shipyard, as a well-chosen solution can contribute to higher productivity, lower material consumption, and greater competitiveness in the market.

Keywords: shipbuilding, steel fabrication, nesting, digital solutions, optimization, ship structure elements

1. Introduction

“Nesting” is a shipbuilding term that refers to the stage in the ship production process where different elements of the ship’s structure—flat plates, in some cases flat profiles, and developed plates of the ship’s hull—are optimally arranged (“nested”) onto stock plates specified in the material order [1].

In addition to its primary purpose of preparing and producing structural elements for subsequent stages of ship construction, the goal of nesting is to maximize material utilization and minimize waste.

The Complete Plate Nesting Process and Input/Output Data

The process begins with the procurement of standard-sized plates, often referred to as raw plates. These are typically ordered in uniform standard dimensions to ensure maximum material utilization in later stages.

In standard practice, the distance between the plate edge and other structural elements, as well as between the elements themselves, ranges from 15 to 30 mm. The arranged parts are positioned to optimally “fill” the plate area, thereby minimizing scrap material.

Well-optimized nesting can significantly reduce plate waste, making it possible to use the remaining material for another section of the ship’s hull—or even for another project. To achieve the best results, the structural elements can be nested using various specialized tools—either automatically or interactively.

During the nesting process, special attention is given to optimizing the cutting tool path and preparing data for CNC-controlled cutting machines.

A variety of nesting software solutions are available on the market, and the selection depends on the shipyard’s existing design software and technological workflow.

Comparison of Specialized Nesting Software

This paper examines key features and compares the functionality of two specialized software solutions designed for shipbuilding and heavy industry:

- ◇ Nestix – a specialized nesting software integrated within the *CADMATIC* software system.
- ◇ Aveva Nesting – a dedicated module within the *AVEVA* software suite, used for automatic nesting of plate elements based on the 3D ship model from the *AVEVA Marine* system (formerly *TRIBON*).

Although both software solutions perform the same core functions, the individual procedures and their implementation differ entirely. Figure 1 represents, in general, the basic *nesting* workflow from CAD software, nesting interface/software towards material fabrication in production.

The analysis was conducted using two separate projects, due to technical and methodological constraints that prevent optimal nesting execution using two different

software tools within a single project. This approach enabled a functionally separate and comparable data analysis, where the specific characteristics of each project were not essential for understanding or interpreting the topic, but served solely as an operational framework for performing the analysis.

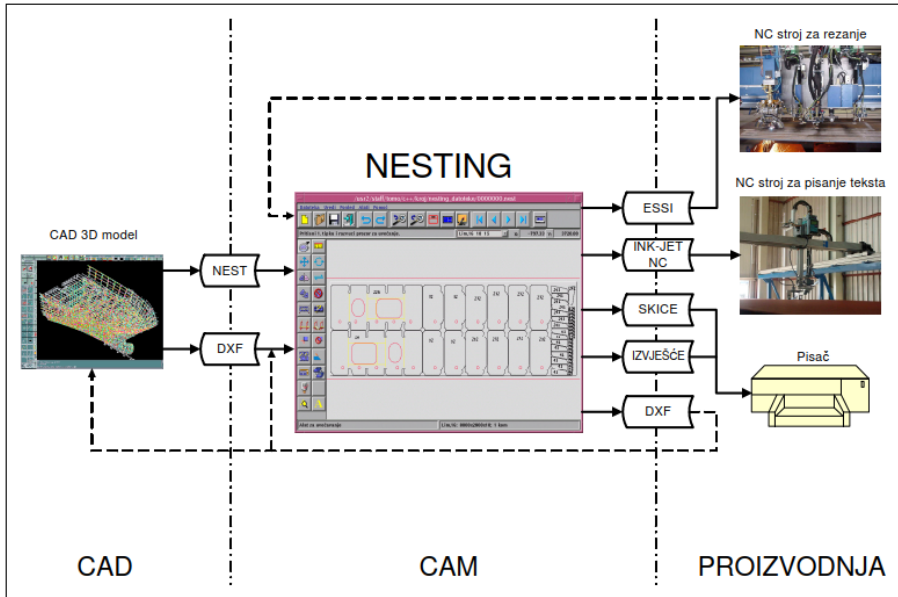


Figure 1. The entire sheet metal cutting process and the input and output data, [2]

2. Preparation of all data for plate cutting

2.1. List of data obtained through the Cadmatic software

Retrieving all data related to the ship structure via the Cadmatic software package involves generating .dxf sketches of all structural elements with key characteristics. These include all section elements that need to be cut and for which cutting programs are created, with attributes such as (screen from software for defining nesting data is show at Figure 2):

- ◇ Element description
- ◇ Section number
- ◇ Workshop mark
- ◇ Project number, section number, workshop mark
- ◇ Date of element creation
- ◇ Quantity of plates with identical features
- ◇ Drawing name

- ◇ Plate thickness
- ◇ Material
- ◇ Project number

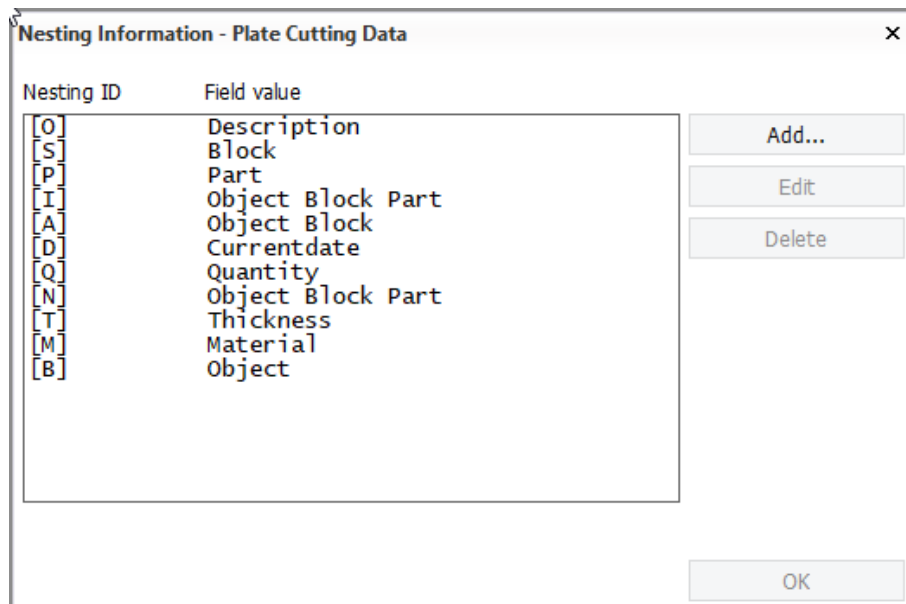


Figure 2 Setting up the main features for sheet metal cutting in Cadmatic software

Cadmatic offers two ways to create .dxf element files:

- ◇ **“Code One Part”** – generates a .dxf for a single element, used mainly for isolated modifications.
- ◇ **“Production Information”** – generates .dxf files for all elements within a section, allowing selection by group (e.g., only knees, plating, specific thickness, or material combinations).

The .dxf file output contains:

- ◇ Element boundaries and dimensions
- ◇ Structural markings and weld preparation descriptions
- ◇ Section and workshop identifiers

Cadmatic automatically orients parts toward the side with the most markings. If both sides have marks, the side with more marks is primary, and opposite marks are labeled with “OS” (opposite side). The user interface from particular software used for defining parameters of dxf file is shown at Figure 3.

Additional features:

- ◇ Main attributes appear at the element's origin edge on the same layer as other lines.
- ◇ Weld preparations are placed on a separate layer so Nestix software recognizes them as structural features.
- ◇ Section or assembly excess (e.g., 20–70 mm) is marked with text such as “OVL50” (although sometimes this marking may be incorrect). Excess areas are used during section assembly before final welding preparation.

Create Production Information ✕

Selection criterion part-list ▾

1544 unique parts Selected : 03-07-2025 21:37:44

Block	Assembly	Panel	SubPanel	Part
205				1528
205				1529
205				1530
205				1531
205				1532
205				1533
205				1534
205				1535
205				1536
205				1537
205				109

No Mounting lines **Mounting lines** **Erection lines**

Yard number

Group number

Drawing number

Measure from base points

Only robot files ▾

Interface to DXF ▾

Configuration ▾

Profile List

Sort on

Update profile list

Report English ▾

Output format ▾

Code block

Code 1 part (NCG) ▾

Results Profile List ▾ **Batch** **OK**

Include bent profiles

Report English ▾

Additional bend length

step size

Burn cutouts

Mark cutouts

No cutouts

Sketches

Only when necessary

All profiles

No Bendingline

Bending Table

Turn

Dimension to the right

With third and fourth endshape

Figure 3 The user interface of Cadmatic when creating .dxf files of the entire section

3. Comparison of nesting 1 – Cadmatic Nestix and nesting 2 – Aveva Nesting

Some of the main advantages and disadvantages between Cadmatic Nestix software and the Aveva Nesting module are of great importance for shipyards when choosing a software package for a complete project. The goal is always to find a solution that is the simplest and allows the shortest possible execution time without additional system modifications. The following table presents the main criteria when selecting the software, as well as their pros and cons.

Material support is considered roughly equal in both programs. Although Nestix is somewhat better adapted and simpler for entering profile data, this option is also available in Aveva Nesting, which makes them quite similar in this respect.

User interface measures how complex it is to adapt and navigate within the software. Aveva Nesting, as a module within the Aveva Marine software package, is quite similar to other Aveva modules, and its data display is familiar to long-term users. The Nestix interface, on the other hand, does not resemble Cadmatic's interface and requires additional training. However, this training is not complicated, and the interface itself is very "user-friendly."

Scrap management is similar in both programs. Nestix tracks and manages leftover material, allowing its reuse if previously saved, just like Aveva Nesting. However, Aveva automatically generates a reuse plan for scrap parts in new projects, whereas Nestix does not notify users about the availability of leftovers—these must be planned manually for future sections or projects.

CNC export is also comparable. Both programs can generate export data tailored to each shipyard's specific cutting technology. It is possible in both cases to export files such as .dxf, .los, and .mpg, which contain the necessary cutting path data and graphical sketches.

Criteria such as industrial application, price, and licensing vary depending on the project size and the shipyard itself. Therefore, they are not emphasized, as they do not directly reflect software performance. Still, it is worth noting that Aveva Nesting is usually cheaper since it comes integrated within the full Aveva package, while Nestix is a standalone product that requires additional licenses.

The remaining criteria will be explained in more detail below, as they reveal the most significant differences that influence a shipyard's choice of software for cutting operations.

3.1. Software Integration

Integration is the most important feature, as it simplifies both the cutting process and CNC export data generation.

Nestix operates exclusively within the Cadmatic environment, receiving data from the Cadmatic Hull module. The biggest drawback is the lack of connection between

the two — Nestix is not a module within Cadmatic but a separate software. Therefore, any model modifications (e.g., changes in thickness, dimensions, or quality) are not automatically reflected in Nestix. Users must manually track every change, re-import data, and redo the nesting process. This is the biggest disadvantage of Nestix, as it greatly increases the possibility of human error. Any unreported modification will not appear in Nestix, resulting in incorrect CNC cutting data and potentially destroying material, since the parts cut from the plate would be wrong.

Aveva has a major advantage in this aspect: every change made in the 3D model is automatically updated in the nesting module. There is no need to manually locate which nesting layout contains the modified element, nor to re-import data via .dxf files as required in Cadmatic.

3.2. Software Flexibility

Software flexibility refers to how easily data from different software packages can be imported for cutting operations. Although both Nestix and Aveva allow importing data in .dwg or .dxf formats, they are not optimized for it.

The main issue is that key attributes (such as thickness, material grade, or quantity) that are automatically generated during export in Cadmatic or Aveva are stored as text within the .dxf file or as part of the structural element in Aveva, eliminating the need for text annotations. However, if a user models in another software (e.g., Rhinoceros 3D), such attributes are not created automatically. The user must either manually enter them during import into Nestix or Aveva, or open the .dxf file and manually create text fields with the main attributes along the element's edges (e.g., section allowance, weld preparation).

3.3 Automatic Optimization

Nestix and Aveva share several similarities regarding optimization. Both have predefined input and output values for the cutting tool and predefined parameters for corner loops (radius, leg length). Once set, these parameters apply to the entire nesting layout.

The biggest differences appear in bridge placement (tabs connecting parts on a plate). Nestix does not have a fully automatic function for placing bridges across the entire nesting, while Aveva does. Aveva allows users to define bridge types and the elements between which they are applied, automatically inserting them throughout the nesting. If adjustments are needed, Aveva provides more precise manual editing — bridges can be added using the cursor or by entering coordinates for high accuracy.

One of Nestix's key advantages is its efficiency in positioning structural elements on the plates. Compared to other methods, Nestix performs this operation faster and with greater accuracy, significantly reducing material waste and achieving optimal layouts during the prenesting phase. This makes Nestix highly effective for improving production efficiency and minimizing waste.

Some clients may request a prenesting phase of a project — a preliminary layout of finished parts on standard-sized plates to estimate the number of plates required. Since the model may not yet have reached the “detailed design” stage, additional material must be allocated for small parts (knees, patches, brackets, etc.). This prenesting layout serves as the basis for ordering the plates needed for the cutting process. Figure 5 and 6 represent layout arrangement of nested elements on basic plate both in Cadmatic (Figure 5) and Aveva (Figure 6).

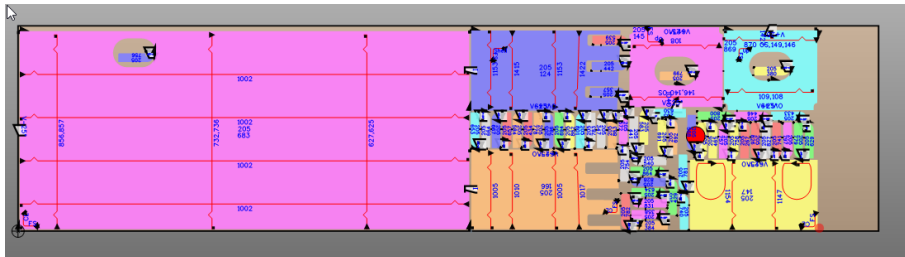


Figure 5 The layout of element arrangement in Nestix (Cadmatic) [4]

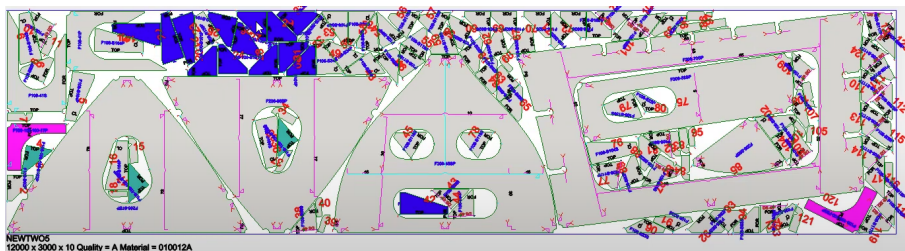


Figure 6 The layout of element arrangement in Aveva Nesting [5]

Comparison Table

Criterion	Nestix (CADMATIC)	Aveva Nesting
Integration	Partial integration with Cadmatic system	Fully integrated within Aveva Marine platform
Material support	Plates, profiles, pipes	Primarily plates, with options for profiles and pipes
Flexibility	Dependent on Cadmatic environment	Lower interoperability
User interface	More complex, requires training	More intuitive for Aveva users

Criterion	Nestix (CADMATIC)	Aveva Nesting
Automatic optimization	Advanced plate layout optimization	Advanced optimization of bridges, corner loops, and tool paths
Scrap management	Tracks and manages leftovers	Detailed management and reuse of leftovers
CNC export	Broad support for various machines and formats	Also supports multiple machines and formats

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5. Conclusion

This study conducted a comprehensive evaluation of two software solutions for sheet metal cutting in shipbuilding: Cadmatic Nestix and Aveva Nesting. Both programs provide a variety of tools that support efficient preparation and optimization of the sheet cutting process, yet they differ in terms of integration, flexibility, and automation. Cadmatic Nestix offers advanced capabilities for optimizing element layouts and precise control over cutting parameters. Its main limitation, however, is the restricted integration with the Cadmatic model, which necessitates additional manual work and increases the likelihood of errors. In contrast, Aveva Nesting benefits from full integration within the Aveva environment, enabling automatic detection of model changes and their direct application in the nesting workflow, thereby improving reliability and reducing production costs.

The comparison indicates that neither software is universally superior. The choice between them depends largely on the shipyard’s specific requirements, technical infrastructure, and production objectives. While Aveva Nesting allows for quicker deployment and reduced error potential in an integrated system, Nestix provides more detailed and flexible control over the nesting process, which can be critical for complex or non-standard projects.

Collaboration with MarDesign Rijeka added significant practical insights from the shipbuilding industry. This partnership provided access to diverse, reliable documentation and real-world engineering practices, offering a deeper understanding of the challenges encountered by professionals in this field.

In summary, selecting and implementing the appropriate nesting software can significantly enhance production efficiency, minimize material waste, and optimize resource use — all essential factors in modern shipbuilding.

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