

A mathematical approach for linking/integrating management plans: Marine Spatial Planning (MSP) and Integrated Coastal Zone Management (ICZM) as a case study

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Abstract. This research has proposed the Management Plan’s Linking/Integrating Methodology (MPLIM), that is articulated around the fundamental differences between the management plans to be linked. MPLIM consists of five main steps: identification of similar sectors or actions between the two management plans; evaluating management plans; identifying and classifying the differences between the management plans into themes; analysing the differences and making recommendations; and lastly, linking all desirable sectors or actions. MPLIM approach had been justified with the help of geometrical shapes and mathematical formulae, based on the concept of union and intersection sets. However, it is the preparation for linkage that is the challenge and not the link itself, as the link is taking decisions that are in favour of all parties, supported by the harmony generated from the recommendations step. When implementing MPLIM approach on two-management plans concepts (i.e., Integrated Coastal Zone Management, ICZM and Marine Spatial Planning, MSP), it was noted that the proposed methodology could be used as a promising tool for linking/integrating various management plans. In addition, it turned out that it facilitated understanding of stubborn conceptual issues related to ICZM and MSP and their relations.

Keywords: maritime spatial planning, integrated coastal zone management, linking, integrating.

1. Introduction

Some of the industries regarded the linkage of management plans very important as it helped in conserving efforts and costs. The “merging plans” concept is usually used for the mobile service robots, where it refers to the merger of all software algorithm-based activities, which had to be simultaneously performed

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(Foulser et al., 1992; Alami et al., 1997). From another perspective, in the case of management plans, different terms had been used for indicating a similar or same meaning, such as merging, integrating or linking which are generally used interchangeably.

For instance, a linkage between departments and their management plans ensures that every entity maintains its identity, however, the linkage, means that every management plan or entity can coordinate its activities with other plans, systems or departments. During integration, one of the systems integrates or becomes a part of a different system, however, its identity is maintained. Nevertheless, during a merging, every component loses its identity when it forms a different system, agency/department or plan. In this chapter, the main focus is on linking/integrating; since both are generally used in the context of management plans (Figure 1). These terms have been properly defined below (Dictionaries, 2013).

Link is defined as “making, forming, or suggesting a connection between two entities”. *Integrate* indicates “combining (one entity) with another entity for forming a whole new component”. Here, though one system became a part of another system, every system was able to maintain its original identity. *Merge* indicates “combining or presenting causes for combining and forming one new entity”.

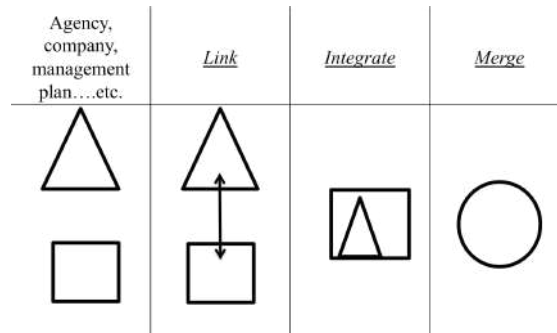


Figure 1: Description of how the linkage, integration, and merger functions operate; it has been developed based on the definitions mentioned above. It can be seen that in *link* each entity is staying as is yet linked with the other entity, whereas in *integrate* both entities are combined together, nevertheless, each entity still enjoy its own shape and characteristics and maintain its original identity; and finally, in *merge* both entities lost their shape and uniqueness and they formed one new entity with new shape and characteristics.

However, speaking of two plans or authorities that are managing two domains Marine Spatial Planning (MSP) and Integrated Coastal Zone Management (ICZM) is a vivid example, as both those concepts manage sometimes similar areas owing to the overlaps noted between the Territorial Waters (TWs) (under the ICZM focus) and Exclusive Economic Zones (EEZ) (under the MSP focus). Hence, the overlapped regions must be addressed appropriately for avoiding any arising conflicts. Add to that, the fuzziness of borders due to the dynamic nature of the coast makes it difficult to be clearly defined (Douvere and Maes, 2010). Moreover, the boundaries for management and planning efforts are often established based on political considerations and not necessarily meaningful from an ecological perspective (Douvere and Maes, 2010), as effects may originate outside the boundary of the management areas (Alvarez-Romero, 2011), such as the negative consequences that arise from the trans-boundary nature of ecosystems (Beger et al., 2010), not to forget the dynamicity of marine waters and some of its habitats. Thus calls were made to link or integrate ICZM and MSP plans (see...Stoms et al., 2005; Cao and Wong 2007; Ehler 2008; Alvarez-Romero et al., 2011; Flannery and Cinnéide 2012; Kidd and Ellis 2012; Queffelec and Maes 2013; Ferreira et al., 2014; Guneroglu et al., 2014; Kerr et al., 2014; Becker-Weinberg 2015; Saunders et al., 2016), thus, this research aimed to propose a methodology that can be used for linking or integrating management plans. And the Hypothesis is as follows: in case of two management plans ICZM and MSP that include similar elements, those elements and activities can be linked while, each management plan still works independently.

This study has several limitations; where it only focused on a theoretical review of the ICZM and MSP on a regional scale of EU and the differences between them.

2. Literature review

Many researchers tried different approaches while investigating the linkage or integration related to the management plans (Stoms et al., 2005; Cao and Wong 2007; Ehler 2008; Alvarez-Romero et al., 2011; Flannery and Cinnéide 2012; Kidd and Ellis 2012; Queffelec and Maes 2013; Ferreira et al., 2014; Guneroglu et al., 2014; Kerr et al., 2014; Becker-Weinberg 2015; Saunders et al., 2016). A few of these papers focused on the integration between the land and sea regions, while some others investigated the management of marine regions. However, it was not clear what the researchers meant exactly by (linkage or integration) as those words are used interchangeably. As there was no specific explanation to any of those terms when presented, or in other words, what should be done in details to accomplish the linkage or integration process.

In more details, Alvarez-Romero et al. (2011) highlighted the need to study the land-sea linkages for conservation planning. They recommended a new operational framework that included three stages regional scoping (like planning domain, evaluation of the conservation context, etc.), analysis and inte-

gration (cross-system warnings, ecosystem-based services, biodiversity in the areas, etc.), and synthesis (schedule regions and activities, general technical results, etc.). In addition, Smith et al. (2011) argued that the integration of the land-sea planning was handled using two contexts – one was related to the planning framework; while the second was related to the environmental management context, like conservation planning. Moreover, Queffelec and Maes (2013), used a framework for coastal and marine strategies at the national or sub-national levels. In this framework, they developed the MSP into the operational or strategic stages. MSP was seen to be an operational device and was an important component of the ICZM plan, as noted in Belgium. Here the MSP zoning was included in the ICZM. Add to that, Ferreira et al. (2014) presented questions that have to be addressed before initiating the integration process, like “Are there (effective) national policies or plans for oceans and coasts? Are the ICM strategies and MSP policies aligned properly? Are all agencies that are responsible for the MSP and ICM properly coordinated? Do the different policies/plans share common indicators, objectives and integrative measures?”. And finally, Saunders et al. (2016) highlighted the significance of using a horizontal integration approach between the sectors, as it was vital for the explicit management along with vertical integration. For example, the German authorities divided the different administrative responsibilities for marine spaces, which improved the border planning between regions with different planning systems and jurisdictions that existed simultaneously.

In a summary, the (linkage and/or integration) approaches were addressed based on four perspectives. The first perspective considered the points that need to be taken into consideration before or during the linking process, though this approach of vital importance, yet, it only focused at what to consider before initiating the linkage/integration process, and it lack details. The second approach addressed the context of the linking procedure (which lay in the planning/conservation planning framework), here, its clear that the focus is on conservation only, and this may ignore economical domains within the plans. The third approach highlighted the importance of including the MSP and ICZM strategies within each other, here; the concentration is on the strategies, which are related to the big picture, not the details of the MSP and ICZM plans or concepts. And finally the fourth approach presented the significance of including the horizontal and vertical integration strategies before linking the plans, though considering vertical (hierarchy) and horizontal (between entities at the same level) is of vital importance, but again it can be seen as an organizational approach rather than being micro (considering all details of the plans). Although these approaches are of vital importance in addressing different issues, however, when implemented, they resulted certain difficulties (Queffelec and Maes, 2013) such as duplication of efforts and lack of implementation (Ferreira et al., 2014), overlap of jurisdictions (Lau, 2005; Cao and Wong, 2007; Saunders et al., 2016) and a fragmented approach. In addition, none of the studies has proposed a

linkage or integration methodology that addresses the management plans based on their outputs (the contents of the plans themselves).

In other fields, the linkage of an archaeological site's artefacts is being considered vital in identifying possible linkage through time and space (Cardinal, 2019). Though the linking of the physical artefacts differs from the linking of management plans, the approach used is interesting as it considers the spatial and temporal components of these pieces, based on the periods and location's sites.

3. Management Plan'S Linking/Integrating Methodology (MPLIM)

In case of two different management plans manage different domains and environments, and they consist of some similar and differing components (physical components, physical factors, human applications, constructed structures, services, etc.), linking them could be an option to overcome many challenges related to their implementation, particularly when the management actions of both of them are considered to be boundary-less.

The procedure to link the management plans can be initiated by establishing a connection node between all similar elements of the plans. Thus, one needs to understand which factors related to the elements and data of the plans display an empirical association. Thereafter the initial structural linkage needs to be established based on the observed results of the plans, which are going to be linked. However, because the plans have different components/elements and structures; the conceptual differences between these management plans need to be understood before any further progress. Furthermore, since all the plans have to undergo a preparation cycle before their actual implementation and their assessment, it is recommended to evaluate the plans before the initiation of any linkage. This helps in identifying the gaps and the missing features within the plans, which could hinder the linking process in its advanced stage. This evaluation would also help in determining the missing features in the theoretical components of the plan.

3.1 Analytical approach to the methodology

Assume two different management plans (i.e., plan1 and plan2) as shown in (Figure 2).

Plan1 and Plan2 manage different geographical regions/domains; wherein every plan consists of several components (physical components, physical factors, human applications, constructed structures, services, etc.).

Assume each of this plan is represented by geometrical shape. Plan1 was represented by a square shape; whereas Plan2 was represented by a triangle (*the usage of different geometrical shapes is to indicate that the management plans were not identical, as they consisted of different geographical domains, different areas of interest, differing legislations, etc. However, these differences were not*

definitive and the plans could share some of the features of the same geographical domains or sectors).

It is assumed that every plan consisted of different elements and components that are represented by different letters (a, b, c, d) for plan1; while plan2 was represented by (c, d, e, f) as shown in (Table 1).

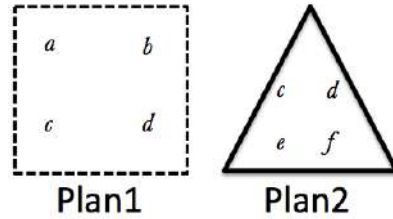


Figure 2: The different hypothetical shapes represented different management plans (i.e., 1 and 2). The different geometrical shapes indicated that both the management plans were not identical. The letters (c, d) represented the similar elements that exist in both plans, however, (d) represented the elements that appeared after evaluation. The letters (a, b, e, f) represented the differing elements/components in the plans, however, The elements (b, f) represented the missing elements/components in the management that appeared after evaluation.

Table 1: Elements of both plans and what do they represent. The elements that appeared after evaluation (b, f) meant to be the elements that are present on papers, yet, missing on ground, due to unknown reasons

Plan1 elements	Plan2 elements	Status
a	e	Exist (different and unique elements/components existed in one plan and not the other)
b	f	Appeared after evaluation (those elements were missing) (different and unique elements/components existed in one plan and not the other)
c	c	Exist (the similar elements that exist in both plans)
d	d	Appeared after evaluation (this element was missing) (the similar elements that exist in both plans)

Mathematically, the proposed methodology MPLIM could be described and proven as follows:

Assume $Plan1 = A = a, b, c, d$; $Plan2 = B = c, d, e, f$. As assumed earlier that the evaluation of the plans showed that b, d were missing from A and d, f from B .

The union of two sets A and B is the set of elements which are in A , in B , or in both A and B .

In symbols, $A \sqcup B \{x : x \in A \text{ or } x \in B\}$ then $A \sqcup B = \{a, b, c, d, e, f\}$. (It could be noted that no repetition of element appeared, as well as, the source is neglected). However, a novel concept known as multiset allows the repetition of the elements. It is defined as the “collection of objects (or elements), where the elements can occur multiple times” (Blizard, 1988). Thus, this approach will be called (union+) ($\sqcup+$). It can be applied to overcome the limitations of the set union concept, which does not allow any repetition of the elements

$$\therefore A (\sqcup+) B = \{a, b, c, d, c, d, e, f\};$$

The intersection of two sets A and B , denoted by $A \cap B$, is the set of all objects that are members of both the sets A and B .

In symbols, $A \cap B = \{x : x \in A \text{ or } x \in B\}$ then $A \cap B = \{c, d\}$. It was seen that only two elements (c, d) appeared in the intersection set, owing to the limitations of the classical set functions. However, based on (Blizard, 1988) multiset concept

$$\therefore \text{The (intersection+) } (\cap+) \text{ of } A \text{ and } B = \{c, d, c, d\}$$

The symmetric difference, also known as the disjunctive union, of two sets is the set of elements that are in either of the sets and not in their intersection. The symmetric difference of the sets A and B is $A \Theta B = \{x (x \in A) \Theta (x \in B)\}$ or the symmetric difference can also be expressed as the union of the two sets, minus their intersection

$$\therefore A \Theta B = \{(A \cup B) \setminus (A \cap B)\}, \text{ Then } A \Theta B = \{a, b, e, f\}$$

Therefore, based on the above-mentioned information, and Figure 2, the MPLIM could be described as illustrated in (Figure 3).

3.2 Steps of MPLIM

Based on the above-mentioned mathematical approach the steps of MPLIM are as follows

1. **Step 1: Identifying the potential sectors of linkage.** This step must be carried out first. If the plans show potential sectors to be linked, the process can be continued further. Or else, the process needs to be stopped. *However, there is a wide list of sectors to choose from*

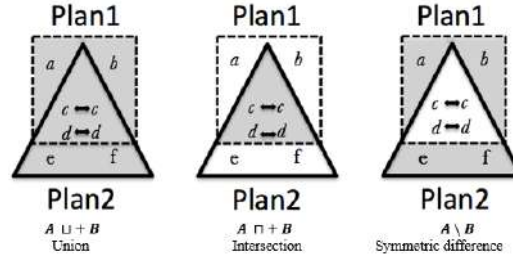


Figure 3: The Union, Intersection and Symmetric difference of two management plans are shown in grey color (shaded). These plans share the c, d, c, d elements and could be effectively linked. The elements a, b, e, f represent the different elements which have to be handled independently. Figure 2 presents additional details regarding this Figure.

and could include hard or soft elements/components. The hard elements include those which are based on their physical presence of any element; whereas the soft elements are those which are associated with the performance, knowledge or actions of associative agencies.

- The intersection + set represent all possible linkage nodes between both management plans or in other words the potential sectors or elements that could be linked.
 - $A(\cup+)B = \{c, c\}$; **before the evaluation of management plans**, thus there are possible sectors that could be linked and we may proceed to the next step.
2. **Step 2: Evaluating the management plans** which to be linked, it is recommended to fulfill and address those gaps before initiating the linkage.
 - Appeared after the evaluation of management plans $\{d, d, b, f\}$.
 3. **Step 3: Identifying the differences** seen between the management plans and then categorising them into various themes; as this will facilitate addressing it.
 - The symmetric difference set, which is represented as

$$A\Theta B = \{(A \cup B) \setminus (A \cap B)\}, \text{ Then } A\Theta B = \{a, b, e, f\}$$
 - The differing elements to be classified into themes according to their shape or the topic they address.
 4. **Step 4: Recommendations.**

- At this stage recommendation regarding linkage should be addressed, as for instance in case of two similar elements to be linked, the differences between management plans should be respected and considered. In our case, the elements $\{a, b, e, f\}$ could be soft (actions or performances) or hard elements (sectors).
- Thus, while linking, for instance, (c element) from *Plan1* and (c element) from *Plan2* or d and d , we should keep in mind the differences in a, b, e, f . The reason to say that is because differences are generally affecting the similarities, as (elements c or d) are not independent rather they are an elements that generally cannot be found solely without being part of all (affecting and being affected). For instance, in case of the fishing sector its affecting other sectors such as shipping lanes and being affected by the seasonal and climate changes in addition to the humans actions and behaviours.

5. **Step 5: Link the desired sectors.** This step addresses the link between the two sectors from a management plan perspective and not from outside these plans. Hence, the results of the linkage between the plans would be compatible with the plans. In this context, the representatives of the other sectors can enrich the database during the linkage process. It was stated that by addressing this linkage, the researchers could save a lot of time and energy (Figure 4).

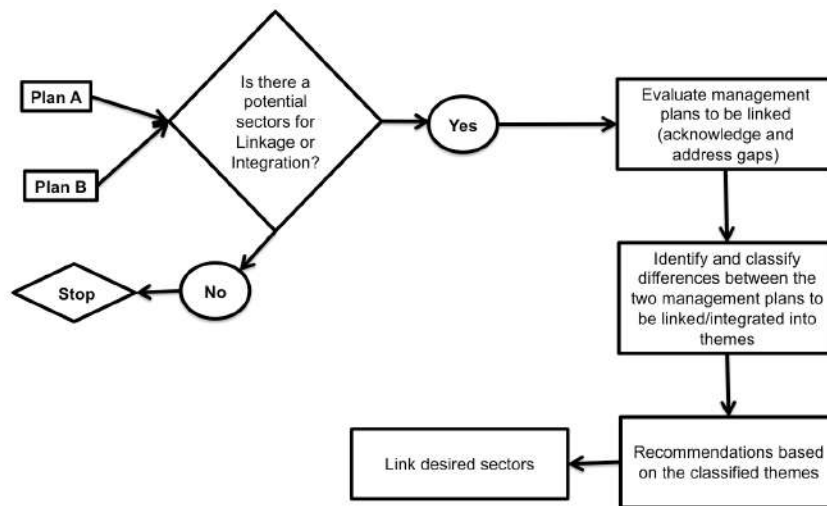


Figure 4: Summary of the applied MPLIM Steps

The following **MPLIM principles** should be observed during the process:

- **Sequentially**; this technique included the determination and definition of empirical interrelationships. Hence, this step must be carried out before

evaluating the plans that to be linked. For example, if no connection nodes are seen between the plans, the evaluation plans step needs to be stopped. Thus in determining the potential linkage nodes the following questions should be answered

- How many potential connection nodes can be established?
 - Which of the spatial, temporal and cognitive elements in *Plan1* correspond to similar elements in *Plan2*?
- **Participatory**; this considers the interests of all stakeholders since many activities are conducted in the management plan sector and they could negatively affect other domains. This will ensure higher chances of linkage's success.
 - **Local specificity**; this addresses the plan and their differences since every region uses a unique management plan which differs from plans in the other regions. For example, management plans may have different priorities in different regions.
 - Significance of **addressing the gaps** Determining the gaps in the management plans, will ensure that they are included in the following steps (i.e., identifying the differences), thus, decreases chances of failure of the linkage process.
 - **Emphasis on the differences instead of challenges**; the challenges are embedded-within and being caused-by the differences; and not vice versa.
 - **Respect the differences** between the management plans, along with the limitations related to the different activities. As much as energy and time is spent to ensure this, will safeguard that all the parties are equally benefited.
 - **Thematic**; the classification of the differences into themes helps in addressing all differences in a predefined path, comprehensive, harmonized, and levelled.
 - The linkage step must be carried out within the **context** of all management plans, and not between the sectors directly.

The following section presents a case study that explains the MPLIM in more detail, by attempting to link ICZM and MSP. Currently, main focus is on Steps 1, 3 and 4. However, a detailed explanation of Step 2 (evaluation of management plans) by discussing the various evaluations tools is presented. Nevertheless, step 5 was not addressed, as there is no management plans (within the scope of this study) to be linked.

4. Implementing MPLIM on ICZM and MSP

4.1 Calls and reasons for attempting to link MSP and ICZM

The following are the calls for and reasons behind attempting to link between ICZM and MSP as described in (Table 2). The supporting opinions show that many authors highlighted the importance of the linkage/integration between ICZM and MSP with a variety of opinions and reasons.

4.2 Linking the ICZM and MSP plans using MPLIM

4.2.1 Identifying potential sectors for linkage

MSP resembles ICZM in several ways (Douvere and Maes 2010; Queffelec and Maes 2013). For example, both the plans use strategic, adaptive and participatory approaches, which have been integrated into the government agencies and economic sectors (Douvere and Maes 2010). These concepts help in acquiring an ecosystem-based management plan (Queffelec and Maes 2013), which can maximise the compatibilities noted between the human activities and decrease the spatial conflicts noted between nature and human users (Kidd and Ellis 2012).

The similarities noted between the MSP and the ICZM principles were described by the 2002 European Commission (EC) and the Baltic Marine Environment Protection Commission (Helsinki Commission - HELCOM) as long-term perspective and objectives; participation of all stakeholders and relevant administration; adaptive management (learning by doing) and a broad overall perspective; high quality data and information basis such as GIS (use of a combination of instruments); and coherent terrestrial and maritime spatial planning.

Both these concepts also manage similar areas owing to the overlaps noted between the Territorial Waters (TWs) (under the ICZM focus) and Exclusive Economic Zones (EEZ) (under the MSP focus). Hence, the overlapped regions must be addressed appropriately for avoiding any arising conflicts.

With regards to the hard elements (that are physically present such as the different sectors) (Joliffe and Patman (1985) as reported by Clark (1992)) to be linked, the two concepts included similar sectors. In addition to, various soft elements such as (i.e., performance, participation) as will be discussed later within the following chapter (Table 3).

To summaries, there are many potential sectors which can be linked, and this was seen to be a good reason for initiating the linkage between ICZM and MSP concepts. Additionally, an overlap of management areas was noted between these concepts. Thus, there is a need to ensure that the management should be conducted in a harmonised manner.

Table 2: Calls and supporting opinions for linking MSP and ICZM plans

Reason	Supporting opinions
<p>(1) The two concepts manage interconnected domain generally (no ecological boundary could be determined).</p>	<ul style="list-style-type: none"> • Historically, the ICZM and MSP concepts have been proposed to reduce coastal (land and sea) conflicts (Douvere and Maes, 2010). However, the fuzziness of borders due to the dynamic nature of the coast makes it difficult to be clearly defined. • “Not only are coastal and ocean ecosystems connected, the boundaries of these systems often transition slowly, and the boundaries are hard to detect even from the surface of the water. This makes it difficult to delineate definitive boundaries between ecosystems; therefore, the boundaries that are drawn often seem like indiscriminate lines drawn on a map that mean nothing in the context of the ecosystems themselves” (Bareford, 2016). • Boundaries for management and planning efforts are often established based on political considerations and not necessarily meaningful from an ecological perspective (Douvere and Maes, 2010), as effects may originate outside the boundary of the management areas (Alvarez-Romero, 2011), such as the negative consequences that arise from the trans-boundary nature of ecosystems (Beger et al., 2010). • Dynamicity of marine waters and some of its habitats.
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Table 2 – continued from previous page

Reason	Supporting opinions
(2) Calls to link the two concepts.	<ul style="list-style-type: none"> • “Ultimately, marine spatial plans should be consistent with plans developed in the coastal zone. It is therefore important to stop discussing MSP in isolation, and instead, explore the linkages among relevant plans” (Douvere and Maes, 2010). • Past research has revealed that one such linkage might be the potential of MSP in making ICZM more operational, which advances its implementation accordingly by utilising MSP’s focus on spatial planning; the ICZM would thus produce more meaningful results (Douvere and Maes, 2010). • The first European High-Level Forum on Community Strategies for ICZM highlighted a similar viewpoint, where the spatial planning had been recognised as one of the priority themes for the further implementation of ICZM in European coastal zones (Douvere and Maes, 2010). • The PLANCOAST handbook has even illustrated how ICZM can support the implementation of MSP (Smith et al., 2011). • Kidd and Ellis (2012) and Kerr et al. (2014) had emphasised on the importance of the close relationship between marine and coastal planning. For this reason, the European Economic and Social Committee of the Regions had recommended a one-stop shop concept to overcome the challenges in managing marine areas that are up to 200 Nautical Miles (NM) (Becker-Weinberg, 2015).
Continued on next page	

Table 2 – continued from previous page

Reason	Supporting opinions
<p>(3) Calls to integrate the two concepts or inclusion of one of them in the other.</p>	<ul style="list-style-type: none"> ● Guneroglu et al. (2014) argued that MSP should be an integral part of ICZM, wherein MSP can be regarded as an instrument to address integration issues of all scales/levels as a means of supporting the implementation of policy objectives (Queffelec and Maes, 2013). ● Since MSP is focused on maritime and ICZM is land oriented, the former could fill the gaps in ICZM concerning the maritime domain (Queffelec and Maes, 2013), while ICZM could do the same for MSP. ● Ehler (2008) argued that MSP has become one of the most powerful tools for the integrated management of coastal and marine environment concerns. ● Agardy (2010) stated that there should be harmony between land and sea planning due to the continuity of activities, and it is believed that a regional planning would help in overcoming the fragmentation issues faced by both the marine environment and coastal zone. ● Although the EU had not referred MSP in its recommendations on ICZM that was adopted in 2002, it does, however, provide a basis as part of a requirement for all EU countries to develop national ICZM strategies (European Commission, 2002; Douvere and Ehler, 2009), which could be utilised by MSP and for its integration with ICZM. ● Directive 2014/89/EU of the European Parliament and the Council of 23 July 2014, establishing a framework for MSP, emphasised “member states shall aim to promote coherence between MSP and the resulting plan or plans and other processes, such as integrated coastal management or equivalent formal or informal practices”. ● Directive 2013/0074 (COD) established a framework on how to implement ICZM and MSP and what are the legal bases and principles. Although it is mentioned that coherence should be established between ICZM and MSP of a state, it did not mention how to execute it. Thus, the following section will attempt to link both concepts using MPLM.

Potential (sectors) elements to be linked that generally appear in ICZM and MSP plans			
Human usages			Ecosystem/Habitats
Multiple water space use	International sea trade	Coastal settlement and hotels	Oceanic Hydrothermal Vents
Power line approach	Renewable energy	Shipwreck	Sea floor
Dredged channel	Port Terminals	Buoys, e.g., water skiing	Coral reefs
Estuarine reclamation	Dumping of toxic wastes	Coastal trade	Ocean's surface
Marine park	Artificial reef, e.g., fishing	Drainage/irrigation	Intertidal systems
Effluent discharge	Scientific interest	Offshore navigation	Wetland conservation/nature reserve
Flood area	Groin field	Lighthouses	Dune conservation area
Coastal industry/power stations	Artificial beach	Fishing sector	Salt marshes
Estuarine urbanization	Beach mining	Floating or submerged storage tanks	Mudflats
Buoys	Cross-channel ferries	Artificial island	Seagrass
Marina	Military activities, e.g., air-to-sea firing range	Coastal airport	Meadows
Mariculture	Offshore oil/gas rig and undersea pipelines		Mangroves

4.2.2 Evaluation of ICZM and MSP plans which are to be linked or integrated

Evaluation help in learning from successes, failures and in determining the gaps which affect the implementation of a plan. It was presumed that all adjustments made in the planning and decision-making stages could help in managing the coastal sector (Oslen 2003; Jacobson et al., 2014). However, since there are no specific management plans (ICZM and MSP) that have to be linked within the scope of this thesis, the approach had focused only on introducing the evaluation tools that can be used. This step aims at determining the various missing elements along with the non-performing activities of these management plans. However, if the linkage was carried out before determining the missing or immature components, the whole linkage process could be severely affected and the whole process will revert to the first step. Additionally, by evaluating the plans the whole linkage procedure could be improved and accelerated. In addition, there is a need to consider the vulnerable situation of the coastal and marine ecosystems, as these ecosystems are constantly changing. Many approaches have been described for evaluating the ICZM efforts such as generic framework for determining the success (Burbridge 1997), understanding the process indicators (Henocque 2003), progress framework (Olsen 2003), progress indicators (Pickaver et al., 2004), factors affecting the success (Stojanovic et al., 2004), dual-level framework (Billé 2007), coastal sustainability standards (Gallagher 2010) and assessing the ICZM components (Pérez-Cayeiro and Chica-Ruiz 2015). Most of the above research studies classified the assessment into two different categories, i.e., *results-based or progress-based*. The result-based assessment compares the results and the desired objectives; evaluates the three pillars of sustainability; and, determines the different types of outcomes, (which were presented by Olsen (2003) as 1. community activities which improve the coastal approach; 2. different indicators which indicate the successful application of the plans; 3. environmental or economic indicators which highlight the environment or economic which was benefited due to the implementation of a certain plans; and 4. creation of a balance between the social and ecological systems). The progress-based assessments are carried out by determining the actual progress of the plans based on the ICZM cycle and can be measured based on the level of accomplishment for each step (the progress-based evaluations include several outputs like guidelines, management plans and the direction in the criteria).

One of the major issues that should be noted while choosing an evaluation tool is the local specificity; as irrespective of the selected methodology, it must be designed and developed for suiting the coastal initiatives and efforts selected for evaluations. For example, the differences noted between the coastal regions at the national or regional levels with regards to the governance hierarchy, society, nature and interests should be considered before selecting the evaluation technique. In addition, a demonstration of the historical legislations and boundaries during the evaluation process will help identify gaps in the legislations and

governance (if any). These gaps should be addressed separately and resolved before any initiation of a linkage process. With regards to the MSP evaluation, Ehler (2014) proposed a guide for evaluating marine spatial plans. He endorsed it by saying,. The guide designed the evaluation methodology in 8 different steps. However, the fundamental steps include evaluate the effectiveness of the management action, develop the baseline information for the marine spatial plan, choose suitable indicators to be monitored on a regular and continuing basis, and communicate the results to the decision-makers. It should be noted that this methodology employs a results-based approach.

Bareford (2016) in her Ph.D. dissertation entitled *An Evaluation of Coastal and Marine Spatial Plans*. It is clear from the title that the proposed evaluation methodology can be used to address any plan within this domain, and that it appeared from the case studies discussed in the dissertation, such as those that comprised marine bioregional plans from the year 1999. However, the evaluation only assesses what is contained within the written document, not the process that created the document or the outcomes that result from the document. It is important to critically assess the content and quality of plans because they are the major elements of the process which lives into the future (Bareford, 2016).

Hence, the selection of an appropriate methodology for evaluating is based on when and what needs to be further evaluated. This could be carried out after the preparation of the plan, during the implementation of the plans or the comparison of the results with the desirable objectives. Along with the different evaluation methodologies, the selection of an appropriate methodology is also the responsibility of the planners and governments. Furthermore, it must be noted that during the evaluation of the MSP, the planners need to use the ICZM evaluation methodologies (as they may be more advanced) if considered appropriate.

4.2.3 Identification of the differences between the MSP and ICZM plans

Speaking of the differences between the two concepts (ICZM and MSP), many studies have addressed their main characteristics; however, by using the *Cmap-Tools software toolkit* (Cañas et al., 2004), the differences have been identified and divided into themes.

The first theme is related to knowledge, as there are differences between ICZM and MSP. For instance the ICZM knowledge is is tacit in locals minds and it encompass different expertise of the administrative agencies because they are generally realm-specific (Beger et al., 2010). Speaking of MSP knowledge, it is expert knowledge (Saunders et al., 2016). And there is incomplete knowledge of the consequences of human activities on the marine environment (Kerr et al., 2014), even as it can be studied and understood with regards to the coastal land.

The second theme is related to stakeholder. Speaking of ICZM the nature of property rights differences between marine and terrestrial (coastal land) (Kidd and Ellis, 2012) and the sense of belonging to the land for the locals (Kidd and Ellis, 2012; Kerr et al., 2014) are featured aspects. In addition to the private ownership and the sense of belonging to the land by the locals. However, People believe sea is a public property (Bareford, 2016). Add to that, land planners see the sea from the context of visual scenery only, and the sea planners believe that land is their invader (Barale et al., 2009). As a matter of fact, the inhabitants from the sea expect nothing from the land, while the land inhabitants are dependent on the sea and its resources. Nevertheless, There is limited scope for the public to influence decisions within the marine and seabed areas, which are managed by the state on behalf of the public (Kerr et al., 2014). In other words, Flannery et al. (2018) believed that MSP is not facilitating public engagement, except for a few groups, to legitimise the process, and it keeps the power in the hands of the elite or the government.

The third theme is related to the used approach. ICZM approaches are more of landward-oriented (Queffelec and Maes, 2013). Add to that, ICZM principals focus on local specificity. And ICZM is a process-oriented (sectorial) approach that emphasises integration across agencies and sectors, and it rarely addresses the allocation of coastal space for efficient economic development and effective protection of valuable ecological and biological areas (Douvere and Maes, 2010; Smith et al., 2011; Ferreira et al., 2014). Thus, it is driven by the significance of competing for environmental protection and economic development (Kerr et al., 2014). However, MSP is Seaward-oriented. And its principles are based on an ecosystem approach and try not to limit themselves within the political boundary as this approach is trans-boundary (European Commission, 2007; Douvere and Maes, 2010). Moreover, MSP approach is systemic (Ferreira et al., 2014). While acknowledging the need for interagency and cross-sectoral integration, MSP has focused on determining a basis for the efficient and effective allocation of ocean space to economic activities and the designation of areas for conservation and protection (Ehler and Douvere, 2009; Smith et al., 2011; Ferreira et al., 2014). In brief, management priorities are different (Ferreira et al., 2014).

The fourth theme is related to jurisdictional. As the coastal area is generally under the jurisdiction of the local government. However, EEZ water is national jurisdiction (Agardy, 2010) and, in some cases, it is international jurisdiction according to article 86 of UNCLOS (UNCLOS, 1982). Thus, there is a possibility of jurisdictional conflict between authorities (Saunders et al., 2016). Within the same context, ICZM is typically applied to marine zones less than five kilometers from the coastline, while MSP can be applied to much wider areas up to EEZ. However, it is worth noting that the geographic scope of the ICZM Protocol in the Mediterranean extends seaward to the external limit of the TWs that overlaps with the MSP area of interest (Agardy, 2010).

The fifth theme is related to legislation. For instance, the earth Summit UN Conference on Environment and Development (UNCED) that was held in Rio de

Janeiro, Brazil, it had introduced ICZM as an integrated approach for managing coasts in a sustainable manner, and yet it is a non-binding instrument (Cicin-Sain et al., 1998; Meltzer and Canada Dept. of Fisheries and Oceans, 1998; Wheeler et al., 2011; Tiller et al., 2012). Moreover, the EC, in its Recommendation of the European Parliament and of the Council of 30 May 2002 concerning the implementation of ICZM in Europe, reemphasised the importance of ICZM principles and entailed all member states to report to the Commission about the experience with implementation of the Recommendation 45 months after its adoption. However, one of the challenges faced by MSP is the weak international and national legislation. For instance, it is not explicitly specified in UNCLOS or the CBD (Ardron et al., 2008; Saunders et al., 2016). Yet, at the EU regional level, the Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014, while establishing a framework for MSP, played a significant role in recognising MSP at the regional level.

The sixth theme is related to the outputs. Since the expected outputs of both plans are different. While the ICZM strategy, plan or programme is simply an integrated set of desired and integrated outcomes along with an action plan to realise them. However, MSP uses zoning maps and/or a permit system to plan for a marine area or ecosystem that can influence the spatial and temporal distribution of human activities.

4.2.4 Recommendations and link

This research has highlighted the major differences between the two concepts (ICZM and MSP within the European experience), which could act as a guide for linking the plans.

Now at this stage, linkage between any two similar sectors could be initiated as shown in (Figure 5). The attempt here is to link fishing sector from MSP's plan/concept and ICZM's plan/concept; (the word concept used to indicate that there are no particular plans to be linked). However, other sectors such as (navy, ships traffic lanes, renewable energy... etc), needs and concerns also need to be respected and addressed if needed. This would ensure that the decisions made, will be in favour of the two management plans/concepts, and not only one, and that was the sole purpose of linking the plans.

As shown earlier, the differences between these concepts were classified into various themes, i.e., **knowledge-related, perspective-based, approach-based, stakeholders-related, jurisdictional-related, legislation-related, and output-related**. And it's believed this classification will help planners to focus on a particular theme, and address it solely without the interference of other themes.

The approach here could be an elucidation approach and capacity building of planners and to try to harmonise and explain the differences to stakeholders and the possible consequences to their areas/sectors of interest. In addition, it would help them present a recommended technique based on these differences.

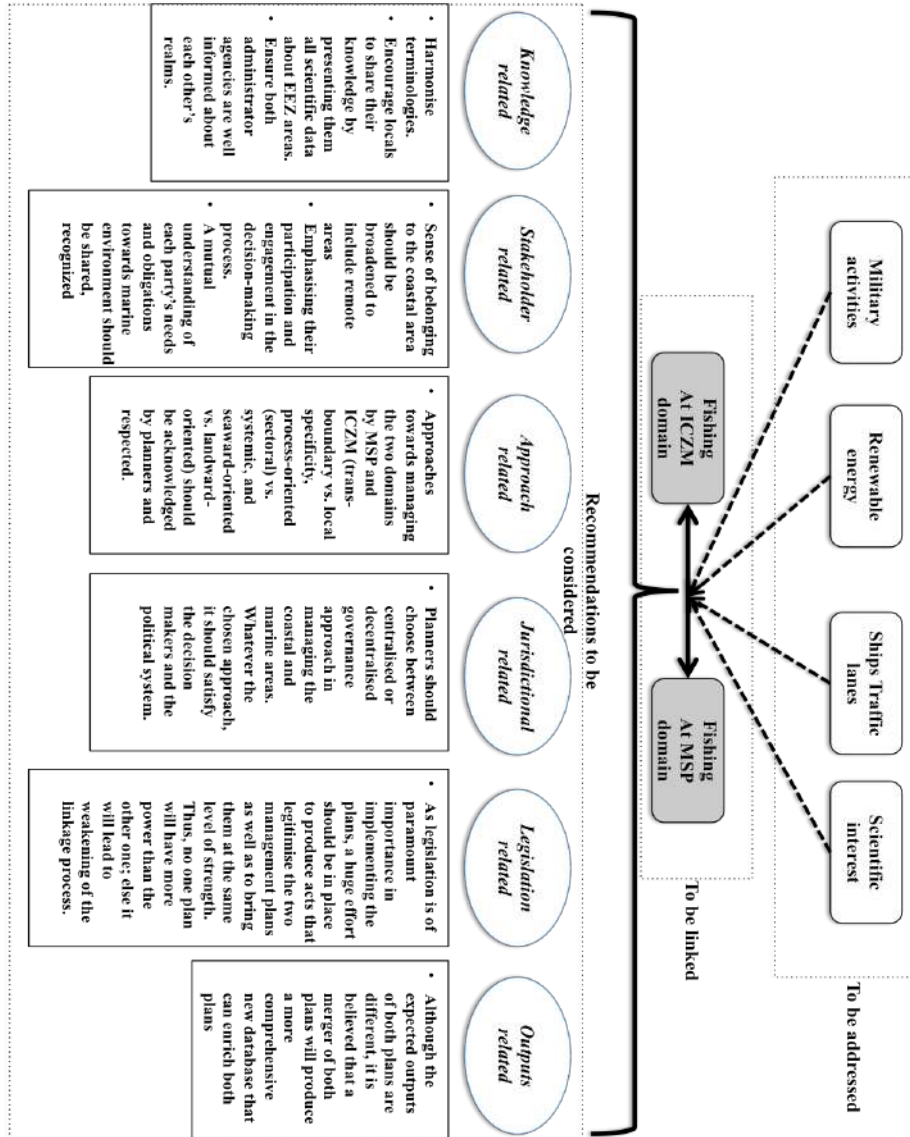


Figure 5: The linkage between the fishing sectors is seen to respect and also address the various sectors. It also considers all recommendations related to the differences.

5. Discussion

The absence of a practical and concise technique for linking management plans encouraged the approach to develop a novel methodology for linking the management plans. The proposed methodology focused on the technique for linking different management plans and was known as the Management Plan Link-

ing/Integrating Methodology (MPLIM). Though there were attempts to link or integrate MSP and ICZM or land and sea plans as argued and discussed by (Stoms et al., 2005; Cao and Wong 2007; Ehler 2008; Alvarez-Romero et al., 2011; Flannery and Cinnéide 2012; Kidd and Ellis 2012; Queffelec and Maes 2013; Ferreira et al., 2014; Guneroglu et al., 2014; Kerr et al., 2014; Becker-Weinberg 2015; Saunders et al., 2016), yet, non of those researches introduced a methodology to be followed. Thus, it's believed that the methodology introduced is a novel technique.

The MPLIM included five steps; these steps were articulated around the fundamental differences noted between the management plans. Though, the importance of identifying differences between the various management plans were also described earlier by Stanwick (2000), yet, it was not specified exactly, how to address those differences.

The justification of the MPLIM was based on the geometric shapes that presented an analytical proof as mentioned earlier. It must be highlighted here that the reason behind using different geometric shapes to represent the two management plans, is to give indication that the plans were not identical, though they may share same elements. This approach is different from previous approaches in mathematical calculation with sets; as they used the circles only to represent sets. May be this approach is acceptable with math, but not with management plans. It is believed that this may be misleading as it indicates that the sets are identical. All in all the geometric shapes assisted in visualisation and helped in determining the different steps of MPLIM, which eventually led to the acceptance of the methodology by author.

When the MPLIM had been implemented on management plans (ICZM and MSP), this technique can help in linking these plans. This technique was further characterised by various features that addressed the linking based on the original plans. This revealed the potential sectors to be linked and the differences between management plans concepts and approaches. However, it was realised that the significance of classifying these differences in various themes as these themes further helped in grouping and addressing the differences more objectively. These differences also highlighted the vital components of both concepts that could not be easily identified before the implementation of the MPLIM. In addition, this study indicated that the differences between both concepts (ICZM and MSP) were more of shape-based and far from being core-based. The reason behind saying that can be justified by the appearance of the many similarities between the two concepts, add to that, the differences between them are not huge, rather, they are basically on the way things were addressed or appeared.

With regards to the recommendation section, it focused on the remediation of all differences seen in the predefined themes. For example, in the case study, the focus was on *knowledge, approaches, stakeholders, jurisdictions, legislation, and outputs themes*; however, the study yielded many notable issues. If these

issues were properly considered, an effective and proper linkage process could be determined.

The approach described in this study differs from other techniques that attempted to link ICZM and MSP plans. As previously researchers developed a new framework and recommended some questions that have to be addressed (Ferreira et al., 2014), while, some used a vertical or horizontal integration process for linking the plans (Saunders et al., 2016). However, these techniques were not benefited from the presence of the original plans, while this study considered the original plans as the start point for linking. It is believed that this will help in saving a lot of time and efforts; as starting from the available plans is of paramount importance in finding details in a fast paced Furthermore, a higher reliance on the differences between the management plans presented a systematic and distinctive approach as it helped in developing a strategy which highlighted what needs to be addressed before linking the plans. However, if no difference is noted between the plans, then the linkage will take place between identical plans, which should not cause any issues. Furthermore, by addressing the differences all challenges could be overridden, since it is believed that *the challenges are embedded-within and being caused-by the differences; and not vice versa*.

This study has several limitations; where it only focused on a theoretical review of the ICZM and MSP on a regional scale (EU) and the differences between them. Furthermore, it presented only the evaluation methodologies that could be used without conducting any evaluation, as no specific management plans were selected for linking within the scope of this study.

6. Conclusions

It's believed that the MPLIM introduced in this thesis could help the planners and governments to link various management plans in various similar sectors. Furthermore, this technique is important as it presented simple steps for initiating the linkage without requiring any new laws or entities. It is perceived that this will help in saving a lot of time and efforts, in addition to preventing the development of any issues during the linkage process.

This study focused on introducing and testing the MPLIM by implementing it on ICZM and MSP, however, it was able to identify potential linkage sectors and analyse the differences between these management plans. The results of this study could help in understanding all issues related to management plans under investigation and linkage.

It is believed that understanding of the cumulative impact on the coastal environment will require the development of a novel and innovative methodological approach that can melts all components and impacts in coastal and marine areas in one crucible. This could help the planners and decision-makers to make a more scientifically informed and better decisions, as it is believed that ICZM or MSP cannot be completed individually unless the other is completed.

Though this methodology was designed to suit MSP and ICZM management plans, yet, it is anticipated that it could be used for linking management plans in other fields.

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