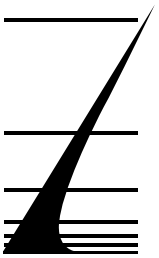
The Market for Anti-Ship Missiles

Product Code #F658

A Special Focused Market Segment Analysis by:



FORECAST INTERNATIONAL

Analysis 3
The Market for Anti-Ship Missiles 2010-2019

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Introduction

The anti-ship missile has helped change the nature of naval warfare. However, the foundation for this shift was laid by the desperate efforts of the Japanese military to stave off impending defeat during World War II.

At the beginning of the Second World War, it was a lucky hit if a single bomb or torpedo was able to sink a major surface combatant, especially an aircraft carrier.

Naval warships proved quite resilient. Adding armored decks to aircraft carriers further improved their durability.

It took two large Japanese aerial attacks on the USS *Yorktown* during the Battle of Midway to finally put this aircraft carrier out of action. Although severely damaged and set ablaze by these strikes on June 4, 1942, the *Yorktown* did not sink until June 7.

As the war turned against Japan, its leaders became increasingly desperate. Japan could not keep up with pilot losses. The "Great Marianas Turkey Shoot," which occurred during the Battle of the Philippine Sea (June 19-20, 1944), resulted in the loss of 375 Japanese aircraft, compared with U.S. losses of 123. Many of the U.S. pilots were rescued and able to return to duty, whereas the majority of the Japanese aircrews were lost. This fighting broke the back of Japan's naval air service. Thereafter, the quantity and quality of Japan's pilot and flight crews would decline.

Adding to Japan's troubles was a growing lack of high-quality aviation fuel. Numerous Japanese aircraft were lost when their engines cut out due to low-quality fuel. This lack of fuel was a further hindrance to training.

In the aftermath of this disaster, the Japanese military leadership realized that desperate times called for desperate measures, and turned to a new weapon, the Kamikaze, for salvation. Japan could not train pilots fast enough with the necessary proficiency to match their opponents, but it could produce pilots with sufficient flying skills to act as the guidance system for its new strike weapon.

Imperial Japanese Navy Vice Adm. Takashiro Ohnishi, commander of the First Air Fleet in the Philippines, helped conceive the Kamikazes (but was not the first to order suicide operations). He noted that an aircraft crashing into a carrier caused more damage than 10 planes strafing it. Therefore, he formed suicide units and ordered his pilots to crash their aircraft (loaded with high explosives) into enemy naval vessels to inflict the maximum amount of damage on American ships with the minimal forces available (the First Air Fleet had 40 aircraft in the Philippines).

This concept was quickly proved on October 25, 1944. On that day, the aircraft carrier USS *St. Lo* was attacked by five Zero fighters off the Philippine coast. Although only one Kamikaze actually hit the ship, the resulting fire caused the ship's bomb magazine to explode, inking the carrier. The success of attacks like the one on the *St. Lo* prompted the Japanese to rapidly expand the program.

Purpose-built Kamikaze aircraft soon appeared, including the Yokosuka MXY7 Ohka. This rocket-powered bomb has been called an anti-ship missile with a human pilot for a guidance system. The first was used in March 1945.

By the end of the Second World War, Japan's naval air service had sent 2,525 Kamikaze pilots to their death, with the Army adding another 1,387 (numerous other Japanese soldiers and sailors died conducting suicide missions that had little influence on the course of the war).

Japanese records claim Kamikazes sank 81 ships and damaged 195. The U.S. military acknowledges the loss of 34 ships, the damaging of another 368 (including 23 aircraft carriers, 5 battleships, 9 cruisers, and 23 destroyers), the death of 4,900 sailors, and the wounding of more than 4,800 servicemen as a result of Kamikaze attacks.

The uncoordinated nature of Japanese Kamikaze attacks and the hoarding of these resources for the defense of the home islands degraded their effectiveness. The Japanese had more than 9,000 planes in the home islands available for Kamikaze attack, and more than 5,000 had already been specially fitted for suicide attack to resist the planned invasion.

Of the Kamikazes sent against the U.S. fleet in Leyte Gulf, about one-quarter scored hits or a damaging near miss.

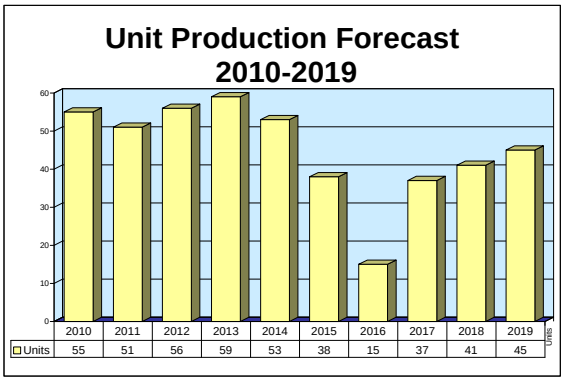
Even with the use of radar, heavy combat air patrols, and massive increases in the number of anti-aircraft guns on U.S. warships, a distressing number of Kamikazes (10-15 percent) were able to successfully crash their aircraft into U.S. surface ships in the last days of the war.

Continued…

OTOMAT

Outlook

- In production
- Italian Navy arms major surface combatants with OTOMAT missiles
- Newest version available is OTOMAT Mk 2 Block IV; Teseo Mk 2/A and OTOMAT Mk 4 are other names for this missile
- OTOMAT to remain operational through 2020
- Further improved OTOMAT may meet Italy's NGASM need



Orientation

Description. Anti-ship missile.

Sponsor. Originally a private development effort but is now sponsored by the French and Italian governments.

Status. The OTOMAT is in production, which is centered on the Mk 3 version.

Total Produced. A total of 1,008 OTOMAT Mk 2, 668 OTOMAT Mk 3, and 239 OTOMAT Mk 4 missiles (including RDT&E units) have been produced or were in production by the end of 2009.

Application. Anti-ship missile designed to be employed on a variety of naval platforms, from a fast patrol boat upward. It is also capable of being launched from land (mobile or fixed installation) and has been experimentally fitted to aircraft for air-to-surface operations.

Price Range. Estimated unit cost of the Italian-produced OTOMAT Mk 2 is $514,800, and the cost of the French-produced missile is about $523,900.

Contractors

Prime

MBDA Italia	http://www.mbda-systems.com, Via Tiburtina 12,400 e Via di, S. Alessandro 8-10, Rome, 00131 Italy, Tel: + 39 06 41971, Prime

Subcontractor

EURENCO, Head Office	http://www.eurenco.com, 12, quai Henri IV, Paris, 75004 France, Tel: + 33 1 49 96 7400, Fax: + 33 1 49 96 7401, Email: eurenco@eurenco.com (Cast PBX Charges)
Protac SA	Route d'Ardon, La Ferté-Saint-Aubin, 45240 France, Tel: + 33 2 38 51 66 66, Fax: + 33 2 38 51 66 33 (Booster Motor)
Thales	http://www.thalesgroup.com, 45, Rue de Villiers, Neuilly-sur-Seine, 92526 France, Tel: + 33 1 57 77 80 00, Fax: + 33 1 57 77 86 59 (AHV-8 Radio Altimeter)

OTOMAT

Turbomeca SA	http://www.turbomeca.com, Bordes, 64511 France, Tel: + 33 5 59 12 50 00, Fax: + 33 5 59 53 15 12 (Arbizon III Turbojet)

Comprehensive information on Contractors can be found in Forecast International's "International Contractors" series. For a detailed description, go to www.forecastinternational.com (see Products & Samples/Governments & Industries) or call + 1 (203) 426-0800.

Contractors are invited to submit updated information to Editor, International Contractors, Forecast International, 22 Commerce Road, Newtown, CT 06470, USA; rich.pettibone@forecast1.com

Technical Data

	Metric	U.S.
Dimensions		
Length overall	446 cm	14.63 ft
Diameter of body	46 cm	1.51 ft
Wingspan	135 cm	4.43 ft
Weight (basic)	770 kg	1,694 lb
Performance		
Speed	Mach 0.9	Mach 0.9
Altitude	Sea-skimmer	Sea-skimmer
Range (min)	6 km	3.24 nm
Range (max) Mk 1	60 km	32.39 nm
Range (max) Mk 2	125 km	67.50 nm
Range (max) Mk 3	180 km	97.19 nm

Propulsion. The boosters are two Protac (formerly Hotchkiss-Brandt/SNPE) composite solid-propellant motors (weighing 75 kg) providing 3,500 kilograms (7,716 lb) of thrust, which burn for four seconds and are jettisoned. At this point, the missile is some 600 meters (1,969 ft) away from the ship, traveling at 1,100 kmph (684 mph), Mach 0.9, at a height of approximately 80 meters (262 ft). In test firings, missile speeds of up to Mach 1.7 were recorded. The sustainer engine is a Turbomeca Arbizon IIIB (formerly TR281) turbojet rated at 3.76 kN (836 lbst). An Arbizon IV engine has been developed that has comparable power but a longer design life of 30 hours.

Control & Guidance. OTOMAT uses autopilot and radar altimeter control during the cruise phase of flight. French-produced OTOMAT missiles employ a Thales 8- to 12-GHz frequency Col Vert two-axis active radar seeker. The Italian OTOMAT missiles, used in the Teseo fire control system, use a Segnalamento Marattimo ed Aero (SMA) ST-2 single-axis homing head, which enables the missile to fly a sea-skimming flight path. A command system is also incorporated in the Teseo system. Both use over-the-horizon targeting systems based upon helicopters to provide midcourse updates.

Saudi Arabia uses the ERATO (Extended Range Targeting of OTOMAT) fire control system. This system is mounted on Saudi Madina class F2000 frigates and can handle up to 16 missiles. The fire-control system allows successive salvo firings at three-second intervals. Eight missiles can be in flight simultaneously, guided toward six different targets.

Launcher Mode. Launched from prepackaged containers that also serve as launchers. The ship-launched and mobile land-based variants of OTOMAT use solid-propellant boosters; however, it was found to be unnecessary to boost the air-launched variant.

When the missile is fitted to a truck platform for coastal battery use, the ship surveillance radar is replaced by a shore-based radar, but target data can still be received from ships and aircraft. Guidance and flight profile are the same as that of the ship-launched missile, including the various fire-control options.

Warhead. High-explosive type with a total weight of 210 kilograms (462 lb). Included are incendiary materials weighing about 150 kilograms (330 lb) and high explosives weighing about 65 kilograms (143 lb). The charge has the ability to penetrate approximately 3.81 centimeters (1.5 in) of armor plate. The warhead is impact- and proximity-fuzed. The proximity fuze allows operation in rough weather, where minimum wave height would probably cause the missile to overfly the deck of the target, but with sufficient blast effect from the warhead to destroy radar, guns, missile

launchers, etc. The impact fuze is timed to allow penetration of the hull and bulkheads before the warhead explodes. In this case, any remaining fuel adds an incendiary effect.

Variants/Upgrades

Five versions of the OTOMAT are in either the planning and development or production stages and include the OTOMAT Mk 1, OTOMAT Mk 2, OTOMAT Mk 3, Teseo 3 (also called OTOMAT Mk 4), and MILAS. The OTOMAT Mk 1, Mk 2, and Mk 3, and the Teseo 3 are anti-ship missiles launched from surface vessels, although other versions for integration with aircraft and submarines are also being considered. The MILAS is an anti-submarine missile system based on the OTOMAT (see separate "MILAS" report in this tab).

For additional information, please see the pertinent entries in the **Program Review** section.

OTOMAT

Source: Alenia Marconi

Program Review

Background. Oto Melara and Engins Matra of France privately entered into a joint venture in 1968 to produce a first-generation anti-ship missile. The missile was named OTOMAT, which is a combination of the first three letters of the Italian (OTO) and French (MAT) corporate titles.

New Missile Deployed in 1976

A fixed-price contract was secured in 1969 (following a design study in 1967), after which engineering development quickly proceeded. Test firings began in 1971 with unguided rounds, but in December, the first guided missile launch failed when one of the solid-propellant booster motors detached prematurely. The first successful guided firing took place in February 1972, and performance trials were completed in May 1973.

The OTOMAT Mk 1 became operational in 1976 with the Italian Navy, where the entire system is called Teseo. Aside from Italy, the missile has since been procured by more than 10 countries (France does not operate OTOMAT).

New Missile. The Italian Navy believes that it will need a new missile to update its anti-shipping operational capability. The current-generation Teseo (OTOMAT) missile system is not considered fully capable of meeting the performance requirements envisaged in coming years, especially in the littoral warfare environment.

The Italian Navy has issued an operational requirement for an advanced surface-to-surface missile system that covers the following:

- subsonic speed
- maximum range of 250+ kilometers
- minimum range of less than 7 kilometers
- inertial and GPS guidance in the intermediate phase with possible preplanned trajectories via waypoints
- high-piercing warhead
- all-weather capability
- imaging IR processing capability with automatic detection, prioritization, autodesignation, and tracking of targets
- man-in-the-loop capability
- waving maneuver in final phase
- kill assessment capability

Sources had believed this requirement could be fulfilled by a further modified version of the OTOMAT, the OTOMAT Mk 4, but now this is known not to be the case. Instead, Italy wants to develop an all-new missile, the Next-Generation Anti-Surface Missile (NGASM). The OTOMAT Mk 4 will be used to meet immediate Italian anti-ship needs.

New Missile Could Be Developed with Foreign Assistance

The Italian and U.S. navies have discussed a possible joint development program, but no formal agreement was reached.

Missile Models. Two missile versions of the OTOMAT have been produced and are being offered in various launch configurations. Proposals have been made for an OTOMAT Mk 3 and OTOMAT Mk 4 (Teseo 3).

OTOMAT Mk 1. The OTOMAT is a long-range, multipurpose anti-ship missile. Although it is intended to be launched from any naval warship, it is capable of being deployed on land (on either fixed or mobile platforms). Additionally, the OTOMAT can be launched from combat aircraft.

The OTOMAT Mk 1 is mounted in a sealed container, which is used for storage, transport, and launch. The container is fitted to deck mountings or coastal battery truck bodies that are pre-aligned at the correct launch angle (12 or 18 degrees). The missile has fixed cruciform wings on the centerbody, with command receivers fitted to the wingtips and four smaller fins at the rear, which are powered by actuators for attitude changes. The Turbomeca Arbizon IIIB turbojet is mounted at the rear of the missile, with an air intake at each of the wing roots. Two solid-propellant Thomson-Brandt boosters are attached to the missile sides.

The original cylindrical container has a length of 4.7 meters (15.4 ft), a cross-section of 1.36 meters (4.46 ft), and an empty weight of 850 kilograms (1,874 lb). The new elliptical container has the same length and width but has a height of 0.84 meters (2.76 ft) and an empty weight of 595 kilograms (1,312 lb). As a result, two of the new containers can be fitted on one deck fitting.

OTOMAT Mk 2. The Mk 2 OTOMAT was introduced soon after the Mk 1 version (about 1978). Development actually commenced in May 1973, before the Mk 1 was operational. The first Mk 2 test firing was conducted in January 1974 (resulting in a direct hit).

The OTOMAT Mk 2 is similar in appearance to the Mk 1, but has increased range and a new single-axis homing head developed by Segnalamento Marittimo ed Aero. This permits the OTOMAT Mk 2 to maintain a sea-skimming profile some six nautical miles prior to impact on a hostile target. The increased range was obtained with the addition of another rocket booster. The OTOMAT Mk 2 is equipped with folding wings and uses a new lightweight launcher.

In mid-1979, the Italian Navy began outfitting its AB212 and SH-3D helicopters with equipment for midcourse correction of the missile during operations. A test firing carried out in December 1979 resulted in a direct hit, following corrections from an AB212 helicopter. That followed a series of five test firings to validate the French missile fire control system CLIO in November 1979. Also in November, it was announced that an OTOMAT Mk 2 had been successfully fired more than 100 kilometers (62 miles). In June 1980, another long-range test was undertaken at the Centre d'Essais des Landes, using the coastal battery launcher. With midcourse corrections from a Super Frelon helicopter equipped with an OMERA surveillance radar, a successful intercept was made at a range of some 150 kilometers (93.2 miles).

OTOMAT Mk 3. Matra, possibly in cooperation with Alenia-OTO Sistemi Missilistici, developed the Mk 3 version of OTOMAT, beginning in 1994 (originally under study as part of a FRF100 million [$19 million] contract). The Mk 3 offered better range than previous versions but also increased the weapon's ability to penetrate anti-missile defenses. This enhanced penetration capability was achieved via the incorporation of stealth technologies and certain improvements associated with the MILAS program (see separate report). Radar-absorbent coatings were added to the OTOMAT, as well as a further infrared signature reduction, possibly through the alteration of the existing

propulsion system or the use of a new powerplant. A new guidance system, provided by Thomson-CSF, enabled the Mk 3 to approach the target via four preselected trajectories and three different waypoints.

Simulations were carried out to demonstrate the missile's ability to avoid detection by future anti-missile defense systems. This program replaced the previous OTOMAT Mk 2 effort, which was to have provided a supersonic missile. A retrofit package allowed existing OTOMAT Mk 2 missiles to be brought up to Mk 3 status.

The OTOMAT Mk 3 and MILAS also shared the same fire control and launching systems. The same combat system on board ship was linked to either a sonar or surface target detector and contained certain specific equipment for providing torpedo data, etc. The Operational Center was similarly configured, with a unique control console that could be operated in either MILAS or OTOMAT mode, with an immediate reconfiguration capability. Both weapons used the same launch tubes, providing various deployment options including eight OTOMAT, eight MILAS, four OTOMAT, and four MILAS, or any other combination. The system could control up to 12 missiles mounted in pairs on six launching cradles.

OTOMAT Mk 4. Italy has been investigating various means for meeting its future anti-ship missile requirements. Solutions have ranged from the development of upgrade kits for existing in-service missiles to the production of an all-new system. Currently, Italy is pursuing both options.

Mk 4 to Carry Production Beyond 2010

The OTOMAT Mk 4 is a further enhancement of the existing OTOMAT Mk 2 missile. The Mk 4 is also known as the OTOMAT Mk 2 Block IV. This upgrade package reportedly involves the modification of the missile's avionics to reduce the volume of the guidance/seeker compartments and increase fuel tank capacity. The Block IV, via a new radar signal processor and GPS receiver, will provide a missile more capable of operating in the littoral environment. The missile will also have a limited land-attack capability. The Block IV will use the insensitive munition warhead and propulsion system from the Block III missile. This missile became available in 2005 and is offered as an upgrade kit or as a new-production system.

Related News

France, Russia Vie for Libyan Defense Contracts – France and Russia are working hard to win defense contracts from Libya. The Libyan military's weapons inventory is in great need of modernization. Libya has the world's ninth-largest oil reserves and is said to have plenty of cash to spend on new hardware for its armed forces. (CNN, 9/09)

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Funding

The Italian defense budget remains under pressure. The budget was increasing through 2004 ($17.5 billion), but then started to fall in 2005 (to $16.96 billion) and 2006 (to $14.76 billion). In the future, the Italian defense budget may again decline.

Pensions, internal security expenditures, and the cost of participation in international operations all mean that the actual defense budget for FY05 was lower than the figure published. Italy is in the process of a major force transformation effort, and this has put additional strain on the nation's defense budget.

The Italian Air Force usually receives the largest portion of the defense budget, followed by the Navy, and then the Army.

Italian Defense Budget Figures

	FY08 QTY	FY08 AMT	FY09 QTY	FY09 AMT	FY10 QTY	FY10 AMT	FY11 QTY	FY11 AMT
Annual Budget	-	22.6	-	18.9	-	18.8	-	18.8

All values are in billions of U.S. dollars.

OTOMAT

Contracts/Orders & Options

In December 2007, the Royal Malaysian Navy announced it would enhance its missile capability, spending some MYR3 billion ($901.1 million) on new naval equipment. As part of this deal, MBDA will upgrade Malaysia's Seawolf air defense missiles at a cost of MYR185.5 million. The contract covers the redesign, build, assembly, installation, testing, integration, and commissioning of articles and refurbishment services for Malaysia's 31 Vertical Launch Seawolf missiles to extend their shelf life for nine years. The program will take 49 months to complete. Procurement of new Seawolf missiles will cost MYR21 million ($6.3 million) each. Comlenia Sdn Bhd will provide spare parts for OTOMAT Mk 2 and Aspide missiles. This is a MYR53 million three-year deal. Comlenia is an authorized agent of MBDA Italia SpA. (Bernama, 12/07)

In August 2006, sources reported that Italy had awarded MBDA a contract for production of the Teseo Mk 2/A (OTOMAT) anti-ship missile. This contract is worth EUR45 million and involves the upgrade of 38 existing missiles (27 for deployment and 11 for training). Deliveries commenced in 2008. The missiles will equip two De la Penne and two Andrea Doria (Horizon) class destroyers. A future option will cover the outfitting of FREMM class warships.

Timetable

Month	Year	Major Development
	1967	Design studies initiated
	1968	Joint venture conceived
	1969	Start of development
Dec	1971	First test firing with guided missile fails
Feb	1972	First successful guided missile test firing
	1976	Low-rate production begun
	1976	Initial Operational Capability
	1977	Full-series production
Feb	1978	OTOMAT program expanded to coastal defense
Oct	1980	Saudi Arabian Navy orders OTOMAT
Apr 25	1985	Successful test firing of OTOMAT Compact at CEL
	1988	Additional Saudi order for OTOMAT
	1989	OTOMAT Mk 2 production continues
	2005	OTOMAT Mk 2 Block IV available
	2016-2017	NGASM available

Worldwide Distribution/Inventories

In 2006, **Libya** mentioned its interest in Italian weapons systems, including missiles. After its long isolation, Tripoli wants to modernize its armed forces, especially the systems in inventory produced by Italy. Talks include the upgrade of in-service OTOMATs.

Algeria may turn to Italy for new frigates instead of France. Algiers was negotiating with France for six FREMM frigates in 2009, but now is looking to Italy instead. Along with the frigates, Italy could provide its OTOMAT or Marte Mk 2/S anti-ship missiles.

User Countries. In addition to the Italian Navy, the OTOMAT has been sold to the following countries: **Egypt**, **Iran**, **Iraq**, **Kenya**, **Libya**, **Malaysia**, **Nigeria**, **Peru**, **Saudi Arabia**, **Venezuela**, and the **Philippines**. **Argentina** and **Brazil** also are reported to have acquired the OTOMAT, though this cannot be confirmed.

Forecast Rationale

Italy prefers to equip its armed forces with weaponry made domestically. Even the integration of Italian missile firms with MBDA, the European tactical missile megacorp, will not change this policy. MBDA brought together missile firms in Italy, France, Germany, and

the United Kingdom, but did not see duplicative production lines shutdown.

MBDA continues to maintain manufacturing lines for anti-ship missiles in France (Exocet), the United Kingdom (Sea Skua), and Italy (OTOMAT and Marte Mk 2). Not until the development of a new generation missile will these nations have an opportunity to rationalize their production lines and procurement programs.

For now, MBDA Italia is the main source of anti-ship missiles for the Italian Navy. Orders from Rome will sustain the OTOMAT line for the immediate future. The Italian Navy will initially arm two Luigi Durand de la Penne class destroyers and two Horizon class frigates with the OTOMAT Mk 2 Block IV (OTOMAT Mk 4) missiles. Thereafter, the Franco-Italian FREMM class warships will receive this missile. Italy will arm its FREMMs with the OTOMAT, while the French Navy is to outfit these frigates with the Exocet.

The Italian Navy plans to keep the OTOMAT anti-ship missile in active service to 2020. Procurement of the new OTOMAT Mk 2 Block IV, also referred to as the OTOMAT Mk 4 and Teseo Mk 2/A, will help achieve this goal. The OTOMAT Mk 4 offers enhanced operational flexibility, allowing the missile to function in the littoral warfare environment and engage land-based coastal targets.

The acquisition of the OTOMAT Mk 4 does not mean that Italy has ceased efforts to find a replacement. Rome has yet to announce whether it will meet its New Generation Anti-Surface Missile (NGASM) requirement with an all-new missile, or opt for a further enhanced version of an existing weapon. Developing an all-new missile may be beyond the Italian Navy's current financial means.

Italy Eyes New Missile

Options open to Italy include the Exocet Block 3, the NSM, and the Naval SCALP. Yet the most attractive entry could be one based on the OTOMAT Mk 4. Building on the OTOMAT Mk 4, Italy could avoid the potentially high cost of an all-new missile development effort. Full-scale development of this missile could begin soon. However, Italy is in no great rush to launch this program. If development begins soon, the NGASM could be ready for fielding around the 2016-2017 timeframe.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR UNIT PRODUCTION

Designation or Program	High Confidence					Good Confidence			Speculative			
	Thru 2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Total
MBDA Italia												
OTOMAT MK.4 <> Italy												
	239	55	51	56	59	53	38	0	0	0	0	312
MFR Not Selected												
Italian Advanced Anti-Ship Missile <> Italy												
	0	0	0	0	0	0	0	15	37	41	45	138
Total	239	55	51	56	59	53	38	15	37	41	45	450

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