

# Evaluation of Environmental Management System Implementation in Construction Projects

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## Abstract

In this article, implementation of ISO 14001 Environmental Management System Standard in construction plants is evaluated. Standard requirements are examined and implementation elaborated for the selected construction plant (central mall) located in Denizli, Turkey.

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**Keywords:** Environmental management system, construction projects, ISO 14001

## Introduction:

In the last three years construction sector has 10% growth and provides significant support on Turkey's national economy and many construction projects are on-going at urban and rural areas of Turkey which have substantial environmental impacts.

Construction projects are being completed very fast and contractors are working in a highly competitive environment with low profit ratios and mostly qualified work force cannot be accessible.

When literature researched among the thesis studies in Turkey, it's observed that implementation of environmental management system evaluated within pharmaceutical, cable, food, glass, plastic, textile and automotive industries however it cannot be seen any direct study conducted regarding implementation of ISO 14001 Environmental Management System in a reference construction plant within construction sector. Main requirements of ISO 14001 are referred in Figure 1.

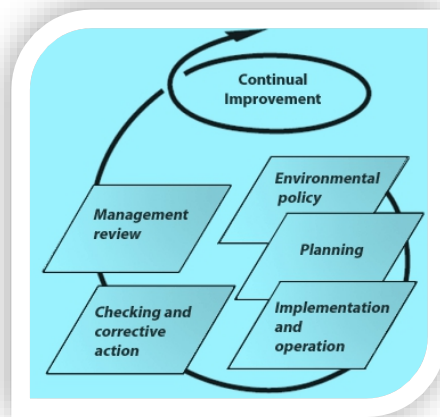


Figure 1 .Continuous Improvement Cycle of ISO 14001

### **Material and Methods:**

In the initial stage quality management systems generally reviewed and ISO 14001 (TSE 2015) is selected for implementation. Standard requirements are examined first and implementation of every standard requirement is elaborated for the selected construction plant in the following stage. Key issues and common problems, gained benefits by execution of this type of international EMS standard are examined.

In the last part of the study, advantages and week points evaluated through the ISO 14001 implementation experiences on referred construction plants. Reference construction plant is selected from the previous work experience of the author which management system implementation studies are carried Akyürek 2007.

Forum Çamlık Shopping Mall Project is built in Denizli City centre at Çamlık District (Figure 2). The owner of this project is aimed and requested to implement three management system standards in an integrated manner.



**Figure 2.** A View from Reference Construction Site Denizli, Turkey

During the construction period; ISO 9001 Quality Management System, ISO 14001 Environmental Management System, OHSAS 18001 Occupational Health and Safety Management Systems are established and implemented. Before establishment of the integrated management system, related training courses are provided to the construction plant staff.

In the starting stage, current situation assessment is carried regarding environmental management needs and required implementation steps are planned. For the environmental impact assessment phase, a collaborated study (Table 1) is carried by the staff from every job discipline by inspection of construction work schedule.

Legal requirements and related regulations regarding environmental and health safety issues are inspected and compliance levels are analysed. Environmental targets are defined and environmental management programs conducted. Environmental performance indicators that have to be tracked by the monitoring and measurement plan (see Table 2) is defined and measured by the required intervals.

In order to prevent deviations from environmental targets; operational control criteria is established, implemented with documented methods. Corrective actions are conducted in every phase of the construction period for the non-conformity areas related with legal compliance, management system failures.

## Results and Discussion

After identification of environmental aspects that arising from construction activities, some of these are selected that have significant impacts on environment. Environmental management programs are arranged to diminish these impacts by usage of defined resources, workmanship and time. Here are the most common examples from the Forum Çamlık Shopping Mall Construction Plant’s (Figure 4) important construction activities their environmental aspects ending with significant impacts;

### Construction Works:

- During isolation works (bituminous membrane application with flame gun) fire hazard and its impacts, soil contamination from oil (lubrication) leakages at mobile machinery, environmental complaints for excessive dust, noise, demolishing debris due to exploding and drilling of defective concrete structures (this case also concerned with quality management regarding that poor quality generates more waste )
- In concrete casting process; environmental complaints from nearby inhabitants for usage of night hours and holidays due to lack of time and abnormal daily hot weathers. Noise and traffic jam because of utilisation of heavy concrete pumps with 47 meters boom length, parking of many concrete mixer trucks wait in queue on the main street.

**Table 1.** An Example Sheet from Environmental Impact Assessment

NO	CONSTRUCTION ACTIVITY	ENVIRONMENTAL ASPECT	Normal (N) Abnormal (AN) Emergency (E)	ENVIRONMENTAL IMPACT	Risk		Legal Req.	Previous Accidents	Effected Environment	SCORE (Before Operational Control)	OPERATIONAL CONTROL/ PREVENTION	Efficiency of the Preventive Measure	SCORE (After the operational control)
					Probability	Result							
1	INSULATION WORKS (Waterproofing)	Usage of bitume based membrane	N	Resource usage	5	1	10	0	0	15			15
2		Bitume based lining usage	N	Resource usage	5	1	10	0	0	15			15
3		Waste steel tins	N	Soil Contamination	5	1	10	10	0	25	PR01 Waste Procedure	-2	23
4		Leakage of bitumeous lining and melted membranes	AN	Soil Contamination	2	2	10	10	0	24	TLM09 Chemical Handling and Storing Work Instruction		24
5		Membrane wastes	N	Soil Contamination	5	2	10	0	0	20	PR01 Waste Procedure		20
6		Laying of polyethylene mattress	N	Resource usage	5	1	0	0	0	5			5
7		Polyethylene and PVC wastes	N	Soil Contamination, Waste Recover y	5	2	10	0	0	20	PR01 PR01 Waste Procedure	-4	16

• Before establishment of environmental management system at the construction plant, all wastes and construction debris was collected and disposed in a mixed manner without any separation with significant environmental impact. After implementation of EMS, many subcontractors, suppliers trained for waste management (sample photos, Figure 3), waste separation areas are erected. Recycled wastes are separated and transferred to the licenced waste management companies, construction debris and demolition wastes are transported to licensed Construction Waste Recovery Plant at the Denizli for the recovery of iron, gravel and sand (please see sample tracking form in Table 4).

**Table 2.** Environmental Monitoring Plan

ENVIRONMENTAL MONITORING & MEASUREMENT	RESPONSIBILITY	MONITORING AND MEASUREMENT FREQUENCY	REMARKS
Noise and Dust Measurement	Health and Safety Engineer-Environmental Engineer	Annual	Will be inspected for every noise resource, in compliance with the regulation.
Exhaust and Flue Gases Emission Measurement	Mechanical Engineer	Annual	Heavy machinery, generator, heating systems etc.
Fuel Consumption	Accountant	Monthly	All vehicles, heating system for camp facilities / Monitoring Chart
Hazardous Wastes Transferred	Site Chief, Environmental Engineer	Every six months	Contractual requirement with İZAYDAŞ Waste Handling Plants/ Monitoring Chart
Office wastes / paper and Plastics	Secretary	Every two weeks	Local Certified Waste Recovery Firm
Sales of Metal Scraps	Site Chief, Site Foreman	Monthly	Separate for iron, copper and aluminium
Recovery Wastes Transferred to the Certified Waste Handling Companies	Site Chief, Site Procurement	Monthly	PVC, PE,PP,PS, paper, steel etc wastes produced in site
Construction Debris	Site Foreman, Site Procurement	Monthly	Transfers to the Municipal Permitted or Certified Construction Debris Recovery Plant
Medical Wastes	Health Technician	15 days	Contract with the Municipal Medical Waste Incineration Plant
Electricity / water and natural gas consumptions	Site accountant, Electrical Engineer	monthly	Monthly bills

- For the expanded and extracted polystyrene wastes with large quantities; in the early stage there was no company recovering this wastes but in the last stage a new factory accepted the collected waste polystyrene for recovery in an another city and transported with trucks.
- For prevention of the oil and gasoline leakages, subcontractors are trained and managed for periodic maintenance, with proven records besides licensed recovery of used oils are tracked by enforcement.

### **Architectural Works:**

- For the masonry works, a study executed for the diminishing of aerated concrete brick and ceramic tile wastes.
- Chemical management procedures are documented and implemented for the paints, adhesives, polishers, thinners and coatings at steel works, insulation, interior decoration, wood works and similar architectural works. Also contaminated boxes and containers of these separated and collected to transport for hazardous waste recovery plants.
- Metal works, precast panels, sheet and deck sheet works, aluminium, suspended ceiling profile works recycling waste impacts defined, recovery system managed, wastes diminished
















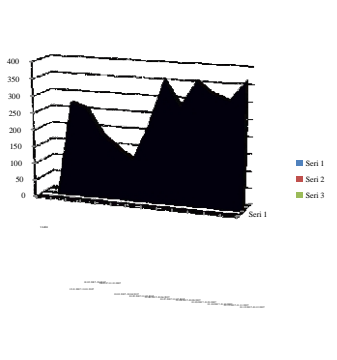
### **Electrical & Mechanical Works:**

- Cable tray, cable, connector, plastic piping wastes, conduit box, plastic piping wastes, thousands of armature packaging wastes,
- Abnormal wastes occurred during the tests and commissioning tests of electrical, mechanical installations, piping network
- Separation and recovery of black steel, galvanised steel pipe wastes erection of water piping, heating cooling, fire installations, during galvanised piping installation; production of contaminated wastes such as oily steel wool, oily rags



Figure 3. Waste management works in the reference construction site (Akyürek 2007)

Table 4: Sample Sheet for Waste Monitoring Charts, Construction Debris (Akyürek 2007)

FR 01 Waste Tracking Form				
FORM REV.NO :0		REV.TAR:02/07/2007		
Unit: Construction site		Responsible : Metin DEMIREL		
<b>PAPER</b> 		<b>PLASTIC</b> 		<b>METAL</b>  Demir  Bakır  Alüminyum
		<b>HAZARDOUS WASTE</b>  Ank Yağ  Ank Filtre  Kontamine  Diğer Tehlikeli Ank		 Kartı / Yıner  Pİ  Kontamine Kap, Ambalaj (Boya, kimyasal tenekesi vb)
				<b>DEBRİS</b> 
				<b>WOOD</b> 
				<b>GLASS</b> 
DATE	Waste quantity (m3)	Licensed Waste Management Organisation /		
12.01.2007-31.01.2007	279	AKÇA Hazır Beton San. Ve Tic. A.Ş. Construction Debris Recovery Plant 		
01.02.2007-28.02.07	265			
28.02.07-31.03.2007	192			
01.03.2007-30.04.2007	155			
01.05.2007-31.05.2007	125			
01.06.2007-30.06.2007	227			
01.07.2007-31.07.2007	361			
01.08.2007-30.08.2007	289			
01.09.2007-31.09.2007	363			
01.10.2007-31.10.2007	331			
01.11.2007-31.11.2007	315			
01.12.2007-30.12.2007	372			
	<b>TOTAL WASTE (m3)</b>	3274	<b>TOTAL TRANSFERRED WASTE</b>	3274

- Separate collection and recovery of Waste polyethylene pipe insulation materials, recovery of waste electrical and communication cables during automation installation

In general;

During site supervision studies; implementation of operational control methods such as waste management, chemicals management, periodical maintenance, safety instructions lowered the (both environmental and safety) accidents and increased the environmental efficiency.

Staff from different subcontractors and main contractor workers periodically trained and site works are daily audited for a better awareness on environmental issues, quality management and safety risks.

Examples of most common cases that need corrective actions are; entrance to site and usage of non-approved materials and products with regard to environmental, quality and safety concerns, removal of recycled

wastes to non-licensed commercial companies by sub-contractors, demolishing and more debris from defective reinforced concrete and other failed structure erections, mixture of contaminated wastes with recycled or non-contaminated wastes, excessive illumination by projectors, damages on nearby households by heavy machinery such as mobile cranes, loaders etc., oil leakages and breakdowns on heavy machinery that not have periodical maintenance, non-monitored emission and noise levels on different vehicles etc.

### **Conclusion:**

In this study, management system view and quality management principals are summarized first and standard requirements of ISO 14001 Environmental Management System are conceptually elaborated and implementation of every standard requirement is detailed for the selected construction plant in the following stage.

As can be seen in sample projects, construction projects are being completed very fast and contractors are working in a highly competitive environment with low profit ratios in our country and mostly qualified work force cannot be accessible.



**Figure 4.** Completed Project Site Denizli, Turkey

Management techniques which is being used in many sector through worldwide has to be adopted in construction sector for the highest quality and increased profit rates. Therefore it's not easy to establish and implement such management systems for the average construction companies with has not adequate back ground and well organised, qualified human resources.

In large scale construction projects there are many work packages which independent or dependent of each other with tens of subcontractors, work areas, various environmental impacts, different raw materials are being used, wastes are derived daily. Therefore coordination of every subcontractor is required a well-established integrated management system (quality, environment, safety), work schedule and material management system. Otherwise environmental impacts, health and safety risk are rising.



Addition to these there are deficits on waste handling and environmental infrastructure for the construction waste and debris. As an example; one of construction company that was implementing ISO 14001 has separated its construction wastes but could not found any licensed waste recovery company to transport these separated wastes at his city, nearby district. In this area public infrastructure is developing in a fast manner with numerous investments however from the initial times for the establishment of environmental management systems, there are still some problems arising.

Also the concept of “construction project management” which is being implemented in successful projects worldwide cannot be implemented except larger projects in Turkey. In case of nonexistence of main management system (quality) implementation of EMSs cannot be managed.

During the studies at the reference construction project, it had been observed that there are many matching points between there management systems such as fulfilment of quality requirements at sample structures also diminishes the wastes, equipment working hours and workmanship losses, increased the efficiency, material losses, safe working methods also ending with prevention of fire, accident, explosion risks, excessive dust, noise and decreased leakages, wastes, environmental impacts.

Hence Turkish contractors with their international large scale projects are rank as the second term at the Engineering News Record List (which ranking world’s first 250 top contractor companies with business volumes) with 42 contractors next to China with 62 contractors at the year of 2014 (ENR 2014).

As a conclusion; main challenges for implementation of environmental management systems at the construction projects in Turkey are; very fast and tight schedules for construction projects and highly competitive environment with low profit ratios for contractors and lower levels of qualified work force in construction sector comparing with other industrial sectors. Addition to this there are deficits on waste handling and environmental infrastructure.

Despite all constraints, EMSs that will be implemented in this industry with commitment of top managements and demand of customers will be an enabling, facilitating tool to determine environmental aspects and impacts of construction sites, will provide higher compliance levels for environmental legislation, to establish best available methods for operational control on waste management, chemicals management etc. and to plan monitoring and measurement, to prioritize environmental aspects for investment schedules and waste management.

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