

CRADLE TO GRAVE TRUCK RADIO MAINTENANCE SYSTEM AS PART OF A MAINTENANCE MANAGEMENT SYSTEM

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INTRODUCTION

Most states equip their snowplow trucks and other vehicles with two-way radios to communicate management and emergency messages. The Illinois Department of Transportation is no exception. Since the 1960's the state has equipped trucks with two-way radios. Originally, installation of the radio enabled the state to decrease the number of snowplow personnel in each truck from two to one. Since then, the mobile radio has become a required and expected management tool. It is very important for the radios to function properly and without failure especially during times of operations such as those involved with snow removal and ice control.

To ensure the radios maintain a high level of readiness, the Department subscribes to a regular maintenance program for all critical radio equipment. In Illinois, the work is performed by a contractor. The experience for the past 20 years has been very positive. However, with the advent of new management systems and decreasing work force, the need to improve the radio maintenance program became very apparent in the last few years.

BACKGROUND

The Illinois Department of Transportation has more than 1,600 single-axle and tandem-axle dump trucks in its fleet. These are radio equipped. In addition, other vehicles such as those provided for the field engineers, front-end loaders at salt stockpiles, special equipment such as vactors and lane strippers, emergency patrol vehicles, construction and other vehicles are radio equipped. These additional vehicles increase the number of radios in vehicles to approximately 4,000 under the control of the Department.

The Department has its own radio communications network consisting of low-band (47 Megahertz) throughout most of the state and a combination high band system (150 Megahertz) and UHF (450 Megahertz) for the District in the Chicago area. For the last several years, the successful bidder for the radio maintenance contract has been Motorola Communications and

Electronics. Motorola contracts with or maintains several local radio maintenance shops across the state. Included in the maintenance contract are not only requirements to maintain the radios on a scheduled basis and respond to unscheduled failures; but also, to install, modify and sometimes replace units. The radio contract is administered by the Central Bureau of Operations in Springfield with a coordinator in each of the Department's nine District offices. The radios are located in a variety of vehicles throughout 108 highway maintenance team sections, several traffic operations headquarters and other bureaus. Therefore, it has been a monumental task to ensure all radios receive proper maintenance on schedule, all repairs are properly accomplished and appropriate billing made. In addition, budgeting of the maintenance contract that includes "cost plus" items and regularly scheduled items, is a very difficult task since unexpected events may trigger increased costs at any point during the fiscal year.

The Department installed a statewide Maintenance Management Information (MMI) System on July 1, 1987. The system includes a central processing cluster consisting of a VAX 6510 and two 8700's. The dedicated lines from 252 terminals in the field directly access data on the database for all users and provide data storage of entries for users at all field locations of the Department.

TRUCK MAINTENANCE

Truck repairs, fuel and oil, and preventative maintenance, have been included in the MMI System. The problems associated with maintaining an equipment fleet are very similar to those for maintaining the radio equipment. After, the Department considered the similarities, a system similar to that for trucks and off-road equipment was designed to manage the radio system. The design of the radio management system requires:

- A complete inventory of all radio equipment;
- Knowledge of the vehicle and "owner" of each radio;

-----SELECTION CRITERIA-----													
CATEGORY LIST	MODEL LIST	YEAR	MAKE LIST	MODEL LIST	ASSIGNED ORGAN.	DELIVERY YEAR	SERVICE CENTER	ON WARRANTY	CONTRACT (B/C/NONE)	DISPOSAL PENDING	SORT ORDER		
801-899	ALL	-	ALL	ALL	088076	ALL	ALL	ALL	Y Y Y	N	INVENTORY NUMBER		
INVEN. NUMBER	ASSIGNED LOCATION	ASSIGN ORG.	CTG CODE	CATEGORY DESCRIPTION	MODEL YEAR	MAKE	MODEL	SERIAL NUMBER	MONTHLY ATTACH TO	MAINT. COST	SERV CTR.	CONT TYPE	ON WAR.
B32148	UNIT G D22061	088076	862	RADIO - MOBILE - LOW BAND	1992	MOTR	MXTRC	428ASS0003	D22061	9.80	0501	C	N
B32150	UNIT A JOHNSON	088076	862	RADIO - MOBILE - LOW BAND	1992	MOTR	MXTRC	428ASS0005	T22613	9.80	0501	C	N
BB6568	DAY LABOR	088076	853	RADIO - PORTABLE - UHF	1993	GE	GP450	9207513		.00	0501	C	Y
BB6578	DAY LABOR	088076	853	RADIO - PORTABLE - UHF	1993	GE	GP450	9207560		.00	0501	C	Y
BB6589	DAY LABOR	088076	853	RADIO - PORTABLE - UHF	1993	GE	GP450	9207610		.00	0501	C	Y
BB6590	DAY LABOR	088076	853	RADIO - PORTABLE - UHF	1993	GE	GP450	9207609		.00	0501	C	Y
BB6591	DAY LABOR	088076	853	RADIO - PORTABLE - UHF	1993	GE	GP450	9207646		.00	0501	C	Y
BB6592	DAY L ABOR	088076	853	RADIO - PORTABLE - UHF	1993	GE	GP450	9207649		.00	0501	C	Y
BB6600	UNIT F JONES	088076	862	RADIO - MOBILE - LOW BAND	1993	MOTR	MXTRC	428ATL5417	T22612	.00	0501	C	Y
BB6626	UNIT F HARBIN	088076	862	RADIO - MOBILE - LOW BAND	1993	MOTR	MXTRC	428ATL3508	T22158	.00	0501	C	Y
BB6627	UNIT GOOLSEN	088076	862	RADIO - MOBILE - LOW BAND	1993	MOTR	MXTRC	428ATL3509	C083314	.00	0501	C	Y
BB6628	UNIT G FOSTER	088076	862	RADIO - MOBILE - LOW BAND	1993	MOTR	MXTRC	428ATL3510	C08314	.00	0501	C	Y
BB6629	UNIT GOBRUNETT	088076	862	RADIO - MOBILE - LOW BAND	1993	MOTR	MXTRC	428ATL3511	C08661	.00	0501	C	Y
BB6630	UNIT B SCARLET	088076	862	RADIO - MOBILE - LOW BAND	1993	MOTR	MXTRC	428ATL3512	C09178	.00	0501	C	Y
BB6631	UNIT D KRIEG	088076	862	RADIO - MOBILE - LOW BAND	1993	MOTR	MXTRC	428ATL3513	T21421	.00	0501	C	Y
BB6632	UNIT A RUDER	088076	862	RADIO - MOBILE - LOW BAND	1993	MOTR	MXTRC	428ATL3514	T22912	.00	0501	C	Y
BB6633	UNIT GOFVRI	088076	862	RADIO - MOBILE - LOW BAND	1993	MOTR	MXTRC	428ATL3515	C09118	.00	0501	C	Y
BB6634	UNIT F MELTON	088076	862	RADIO - MOBILE - LOW BAND	1993	MOTR	MXTRC	428ATL3516	T20931	.00	0501	C	Y
BB6635	UNIT F DYER	088076	862	RADIO - MOBILE - LOW BAND	1993	MO TR	MXTR	428ATL3517	T17991	.00	0501	C	Y
BB6636	UNIT F ACHAS	088076	862	RADIO - MOBILE - LOW BAND	1993	MOTR	MXTRC	428ATL3518	T20932	.00	0501	C	Y
BB6637	UNIT F LEAMON	088076	862	RADIO - MOBILE - LOW BAND	1993	MOTR	MXTRC	428ATL3519	T20074	.00	0501	C	Y
BB6638	UNIT F JARRETT	088076	862	RADIO - MOBILE - LOW BAND	1993	MOTR	MXTRC	428ATL3520	T21603	.00	0501	C	Y
BB6639	UNIT F T21751	088076	862	RADIO - MOBILE - LOW BAND	1993	MOTR	MXTRC	428ATL3521	T21751	.00	0501	C	Y
BB6640	UNIT F T22156	088076	862	RADIO - MOBILE - LOW BAND	1993	MOTR	MXTRC	428ATL3522	T22156	.00	0501	C	Y
BB6641	UNIT F T21750	088076	862	RADIO - MOBILE - LOW BAND	1993	MOTR	MXTRC	428ATL3523	T21750	.00	0501	C	Y
BB6642	UNIT F T22157	088076	862	RADIO - MOBILE - LOW BAND	1993	MOTR	MXTRC	428ATL3524	T22157	.00	0501	C	Y
BB6643	UNIT F T20935	088076	862	RADIO - MOBILE - LOW BAND	1993	MOTR	MXTRC	428ATL3525	T20935	.00	0501	C	Y
BB6644	UNIT F ELDRIDG	088076	862	RADIO - MOBILE - LOW BAND	1993	MOTR	MXTRC	428ATL3526	T21105	.00	0501	C	Y
BB6660	UNIT F T22155	088076	862	RADIO - MOBILE - LOW BAND	1993	MOTR	MXTRC	428ATL3542	T22155	.00	0501	C	Y
D91761	UNIT A JOHNSON	088076	853	RADIO - PORTABLE - UHF	1989	MOTR	HT600	649APC3841		.00			N
D9 1762	UNT A JOHNSON	088076	853	RADIO - PORTABLE - UHF	1989	MOTR	HT600	649APC3842		.00			N
D91763	UNIT G FOSTER	088076	853	RADIO - PORTABLE - UHF	1989	MOTR	HT600	649APC3843		.00			N
D91764	UNIT G FOSTER	088076	853	RADIO - PORTABLE - UHF	1989	MOTR	HT600	649APC3844		.00			N
D91774	UNIT PL JONES	088076	862	RADIO - MOBILE - LOW BAND	1989	MOTR	SYNTR	483HNS0167	T20932	.00	0501	C	N
D91777	UNIT D MCSPARN	088076	862	RADIO - MOBILE - LOW BAND	1990	MOTR	MXTRC	428HQJ2899	T21578	9.80	0501	C	N
D91778	UNIT B HOWLETT	088076	862	RADIO - MOBILE - LOW BAND	1990	MOTR	MXTRC	428HQJ2900	T21579	9.80	0501	C	N
D91779	UNIT A WATKINS	088076	862	RADIO - MOBILE - LOW BAND	1990	MOTR	MXTRC	428HQJ2901	T21580	9.80	0501	C	N
D91780	UNIT B BRITZ	088076	862	RADIO - MOBILE - LOW BAND	1990	MOTR	MXTRC	428HQ J2902	T21581	9.80	0501	C	N
D91781	UNIT D COX	088076	862	RADIO - MOBILE - LOW BAND	1990	MOTR	MXTRC	428HQJ2903	T21582	9.80	0501	C	N
D91782	UNIT A PL	088076	862	RADIO - MOBILE - LOW BAND	1990	MOTR	MXTRC	428HQJ2904	T21583	9.80	0501	C	N
D91783	UNIT D FLETCHR	088076	862	RADIO - MOBILE - LOW BAND	1990	MOTR	MXTRC	428HQJ2905	T21584	9.80	0501	C	N
D91784	UNIT B BASLER	088076	862	RADIO - MOBILE - LOW BAND	1990	MOTR	MXTRC	428HQJ2906	T22614	9.80	0501	C	N
D91785	UNIT G SIDDEMS	088076	862	RADIO - MOBILE - LOW BAND	1990	MOTR	MXTRC	428HQJ2907	T21752	9.80	0501	C	N
D91786	UNIT A ROBINSN	088076	862	RADIO - MOBILE - LOW BAND	1990	MOTR	MXTRC	428HQJ2908	T21753	9.80	0501	C	N
D91787	UNIT A VANATTA	088076	862	RADIO - MOBILE - LOW BAND	1990	MOTR	MXTRC	428HQJ2909	T21072	9.80	0501	C	N

RADIO INVENTORY COUNT: 45

SELECTED RADIOS TOTAL CONTRACT COST:

127.40

*** END OF REPORT ***

FIGURE 1 Example of inventory summary report.

- Information concerning the radio shop responsible for maintenance of each radio on inventory;
- The schedule of maintenance for each component of the radio system (base stations, mobile units, towers, etc.);
- Access for inquiry for all users;
- A preventive maintenance "warning" forecast of equipment needing attention within the next 30 to 60 days; and
- Various reports containing lists of charges, warnings and budget projections.

With these goals in mind, the Department spent approximately one year to develop, test and implement a radio management system to provide this information to all users. The system was initialized January 1, 1994 and is operational at this time.

DISCUSSION

The first step in the process was to develop a complete inventory of all radios within the Department. The

ORGANIZATION 088076 DAY LABOR

INV NO	YEAR	MAKE	MODEL	ATTACH TO	OVERDUE
CATEGORY : 862 RADIO - MOBILE - LOW BAND					
B32148	1992	MOTR	MXTRC	D22061	LAST INSPECTION // / 12 MONTH INSPECTION OVERDUE 09/01/93
B32150	1992	MOTR	MXTRC	T22613	LAST INSPECTION // / 12 MONTH INSPECTION OVERDUE 09/01/93
D91774	1989	MOTR	SYNTR	T20932	LAST INSPECTION // / 12 MONTH INSPECTION OVERDUE 06/21/90 ****
D91777	1990	MOTR	MXTRC	T21578	LAST INSPECTION // / 12 MONTH INSPECTION OVERDUE 06/12/91 ****
D91778	1990	MOTR	MXTRC	T21579	LAST INSPECTION // / 12 MONTH INSPECTION OVERDUE 06/12/91 ****
D91779	1990	MOTR	MXTRC	T21580	LAST INSPECTION // / 12 MONTH INSPECTION OVERDUE 06/12/91 ****
D91780	1990	MOTR	MXTRC	T21581	LAST INSPECTION // / 12 MONTH INSPECTION OVERDUE 06/12/91 ****
D91781	1990	MOTR	MXTRC	T21582	LAST INSPECTION // / 12 MONTH INSPECTION OVERDUE 06/12/91 ****
D91782	1990	MOTR	MXTRC	T21583	LAST INSPECTION // / 12 MONTH INSPECTION OVERDUE 06/12/91 ****
D91783	1990	MOTR	MXTRC	T21584	LAST INSPECTION // / 12 MONTH INSPECTION OVERDUE 06/12/91 ****
D91784	1990	MOTR	MXTRC	T22614	LAST INSPECTION // / 12 MONTH INSPECTION OVERDUE 06/12/91 ****
D91785	1990	MOTR	MXTRC	T21752	LAST INSPECTION // / 12 MONTH INSPECTION OVERDUE 06/12/91 ****
D91786	1990	MOTR	MXTRC	T21753	LAST INSPECTION // / 12 MONTH INSPECTION OVERDUE 06/12/91 ****
D91787	1990	MOTR	MXTRC	T21072	LAST INSPECTION // / 12 MONTH INSPECTION OVERDUE 06/12/91 ****

*** END OF REPORT ***

FIGURE 2 Example of PM reminder report.

MMIS412 MMIG4333 MMIR448 ILLINOIS DEPARTMENT OF TRANSPORTATION PAGE: 1
 05/24/94 145432 BUREAU OF OPERATIONS
 EQUIPMENT WARRANTY EXPIRATION LISTING

SELECT CRITERIA: CATEGORY CODE = 862-862 ASSIGNED ORGANIZATION = 800000 DISTRICT 8 SORTED BY EXPIRATION DATE

EXPIRATION DATE	INVEN. NUMBER	MODEL YEAR	MAKE	MODEL	SERIAL NUMBER	ATTACHED TO	EXP.
862 RADIO - MOBILE - LOW BAND							
07/23/94	BB3413	1993	MOTR	MRTRC	776ATL0583	T23040	
07/26/94	BB3817	1993	MOTR	MRTRC	776ATL0578	T22901	
07/26/94	BB3816	1993	MOTR	MRTRC	776ATL0585	T22900	
07/26/94	BB3897	1993	MOTR	MXTRC	428ATL5728	T22902	
07/26/94	BB3412	1993	MOTR	MRTRC	776ATL0586	C09452	
07/26/94	BB3898	1993	MOTR	MXTRC	428ATL5722	T23030	
07/26/94	BB3903	1993	MOTR	MXTRC	428ATL5651	T23026	
07/26/94	BB3889	1993	MOTR	MXTRC	428ATL5672	T23032	
07/26/94	BB3818	1993	MOTR	MRTRC	776ATL0595	T23107	
07/29/94	BB3905	1993	MOTR	MXTRC	428ATL5655	T23031	
07/29/94	BB3821	1993	MOTR	MRTRC	776ATL0572	T23034	
07/29/94	BB3892	1993	MOTR	MXTRC	428ATL5663	T23036	
07/29/94	BB3820	1993	MOTR	MRTRC	776ATL0576	T23033	
07/29/94	BB3895	1993	MOTR	MXTRC	428ATL5682	T23035	
07/29/94	BB3891	1993	MOTR	MXTRC	428ATL5687	T23028	
07/30/94	BB3819	1993	MOTR	MRTRC	776ATL0602	T23029	
07/30/94	BB3822	1993	MOTR	MRTRC	776ATL0580	T23037	
07/30/94	BB3904	1993	MOTR	MXTRC	428ATL5659	T23027	

CATEGORY EQUIP INVENTORY COUNT: 18
 TOTAL EQUIP INVENTORY COUNT: 18

*** END OF REPORT ***

FIGURE 3 Example of warranty expiration report.

MMI System contained an inventory of the radios controlled by the Bureau of Operations (formerly the Bureau of Maintenance) for the Department. Radios were under the control of the Bureaus of Administrative Services, Traffic, Project Implementation, Local Roads and others. Therefore, the first step was to include all radios in the inventory. The inventory information includes many data items necessary for normal inventory

control and some required by the radio management system. The items displayed in Figure 1 are some items included in the inventory. Several are those items specifically included to support the Radio Management System.

A very important observation in the development process for the Radio Management System was the need to include the vehicle or other equipment to which it is

MMIS414 MMIG4329 MMIR447
05/24/94 153017

ILLINOIS DEPARTMENT OF TRANSPORTATION
BUREAU OF OPERATIONS
RADIO IDENTIFIER AND CALL NUMBER LISTING

PAGE: 1

SELECT CRITERIA: CATEGORY CODE = 862-862 ASSIGNED ORGANIZATION = 088076 DAY LABOR SORTED BY IDENTIFIER

CTG.	INV. NO.	I.D. NO.	CALL NO.	VEHICLE #	LICENSE #
862	B32148			D22061	
862	D91774			T22032	
862	BB6660			T22155	
862	BB6600	0200	M-36	T22612	U01569
862	BB6626	0201	M-38	T22158	U04441
862	BB6627	0202	M-21	C08331	U03924
862	BB6628	0203	M-23	C08314	U02296
862	BB6629	0204	M-26	C08661	U02299
862	BB6630	0205	M-28	C09178	U00684
862	BB6631	0206	M-27	T21492	U13835
862	BB6632	0207	M-24	T22912	U07969
862	BB6633	0208	M-20	C09118	U02297
862	BB6634	0209	M-29	T20931	U11227
862	BB6635	0210	M-40	T17991	U10040
862	BB6636	0211		T20932	
862	BB6637	0212	M-37	T20074	U02303
862	BB6638	0213	M-42	T21603	U00944
862	BB6639	0214		T21751	
862	BB6640	0215		T22156	
862	BB6641	0216		T21750	
862	BB6642	0217		T22157	
862	BB6643	0218		T20935	U02307
862	BB6644	0219	M-35	T21105	U04520
862	B32150	0221	M-39	T22613	U00914
862	D91777	0222	M-66	T21578	U00428
862	D91778	0223	M-65	T21579	U00416
862	D91779	0224	M-61	T21580	U00430
862	D91780	0225	M-64	T21581	U17775
862	D91781	0226	M-68	T21582	U13833
862	D91782	0227	M-60	T21583	U00432
862	D91783	0228	M-67	T21584	U00420
862	D91784	0229	M-69	T22614	U02309
862	D91785	0230	M-70	T21752	U07249
862	D91786	0231	M-62	T21753	U18824
862	D91787	0232	M-60	T21072	U13838

*** END OF REPORT ***

FIGURE 4 Example of I.D. cross reference report.

attached with the radio record. This ensures no item can be shown attached to more than one other item. Secondly, it is important to include all the radio maintenance repair shops and to assign all radios to one of these shops. This had already been done informally and is usually governed by the repair shop's proximity. By assigning the radio inventory to a particular repair shop, Motorola guides the workload to the locations most likely to be used. Motorola maintains parallel information for their managers in the field. Third, the maintenance contract includes a price list of the various services to be offered and the cost of each. Most remote field users of the radios are not aware of the costs of repairs or maintenance for their radios. The master contract contains these unit prices, but they are not widely distributed. The cost of repair when made, is

automatically calculated and included. Therefore, the radio contact people in the districts and those requesting repairs can comprehend the cost to maintain their radios and the cost of particular requests.

PREVENTIVE MAINTENANCE

The Department requires all radio equipment be included on a schedule of maintenance. Mobile units, for example, are inspected once a year, base stations twice a year and other equipment on similar schedules. It is important for the Bureau to ensure the contractor has, in fact, performed this maintenance and that all 4,000 radios in the system have been given the appropriate maintenance service (See Figure 2).

SELECT CRITERIA: CATEGORY CODE = 862-862 ASSIGNED ORGANIZATION = 700000 DISTRICT 7 SELECT DATE = 04/94 BY CATEGORY

INV. NBR.	TS	YEAR	MAKE	MODEL	SERIAL NUMBER	CONTRACT TYPE	04/94 FIXED \$'S	04/94 EXTRA \$'S	04/94 TOTAL \$'S	FYTD FIXED \$'S	FYTD EXTRA \$'S	FYTD TOTAL \$'S
CATEGORY: 862 RADIO - MOBILE - LOW BAND												
J18001	732	1992	MOTR	MRTRC	776ASN0290	C	\$ 11.15	\$.00	\$ 11.15	\$ 89.20	\$ 21.75	\$ 110.95
J18002	732	1992	MOTR	MRTRC	776ASN0278	C	\$ 11.15	\$.00	\$ 11.15	\$ 89.20	\$ 21.75	\$ 110.95
J18003	732	1992	MOTR	MXTRC	428ASN1626	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 21.75	\$ 100.15
J18004	732	1992	MOTR	MXTRC	428ASN1631	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 21.75	\$ 100.15
J18005	732	1992	MOTR	MXTRC	428ASN1637	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 133.95	\$ 212.35
J18006	732	1992	MOTR	MXTRC	428ASN1639	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 21.75	\$ 100.15
J18007	732	1992	MOTR	MXTRC	428ASN1643	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 134.20	\$ 212.60
J18008	732	1992	MOTR	MXTRC	428ASN1651	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 134.20	\$ 212.60
J18009	732	1992	MOTR	MXTRC	428ASN1648	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 134.20	\$ 212.60
J18010	732	1992	MOTR	MXTRC	428ASN1632	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 21.75	\$ 100.15
J18011	732	1992	MOTR	MXTRC	428ASN1633	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 170.55	\$ 248.95
J18012	732	1992	MOTR	MXTRC	428ASN1646	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 21.75	\$ 100.15
J18013	732	1992	MOTR	MXTRC	428ASN1644	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 21.75	\$ 100.15
J18014	732	1992	MOTR	MXTRC	428ASN1656	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 21.75	\$ 100.15
J18015	732	1992	MOTR	MXTRC	428ASN1653	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 67.60	\$ 146.00
J18016	732	1992	MOTR	MXTRC	428ASN1650	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 21.75	\$ 100.15
J18017	732	1992	MOTR	MXTRC	428ASN1640	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 21.75	\$ 100.15
J18018	732	1992	MOTR	MXTRC	428ASN1652	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 21.75	\$ 100.15
J18019	742	1992	MOTR	MRTRC	776ASN0286	C	\$ 11.15	\$.00	\$ 11.15	\$ 89.20	\$ 21.75	\$ 110.95
J18020	742	1992	MOTR	MRTRC	776ASN0284	C	\$ 11.15	\$.00	\$ 11.15	\$ 89.20	\$ 21.75	\$ 110.95
J18021	742	1992	MOTR	MXTRC	428ASN1642	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 21.75	\$ 100.15
J18022	742	1992	MOTR	MXTRC	428ASN1647	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 21.75	\$ 100.15
J18023	742	1992	MOTR	MXTRC	428ASN1645	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 97.60	\$ 176.00
J18024	742	1992	MOTR	MXTRC	428ASN1655	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 69.30	\$ 147.70
J18025	742	1992	MOTR	MXTRC	428ASN1627	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 21.75	\$ 100.15
J18026	742	1992	MOTR	MXTRC	428ASN1649	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 97.60	\$ 176.00
J18027	742	1992	MOTR	MXTRC	428ASN1654	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 21.75	\$ 100.15
J18028	742	1992	MOTR	MXTRC	428ASN1630	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 51.75	\$ 130.15
J18029	742	1992	MOTR	MXTRC	428ASN1641	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 21.75	\$ 100.15
J18030	742	1992	MOTR	MXTRC	428ASN1635	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 82.46	\$ 160.86
J18031	742	1992	MOTR	MXTRC	428ASN1628	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 21.75	\$ 100.15
J18032	742	1992	MOTR	MXTRC	28ASN1638	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 21.75	\$ 100.15
J18033	742	1992	MOTR	MXTRC	428ASN1657	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 21.75	\$ 100.15
J18034	731	1992	MOTR	MXTRC	428ASN1629	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 21.75	\$ 100.15
J18035	731	1992	MOTR	MXTRC	428ASN1634	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 170.30	\$ 248.70
J18036	731	1992	MOTR	MXTRC	428ASN1636	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 21.75	\$ 100.15
J18037	731	1992	MOTR	MXTRC	428ASN4710	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 21.75	\$ 100.15
J18038	731	1992	MOTR	MXTRC	428ASN4700	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 21.75	\$ 100.15
J18039	731	1992	MOTR	MXTRC	428ASN4694	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 21.75	\$ 100.15
J18040	731	1992	MOTR	MXTRC	428ASN4689	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 21.75	\$ 100.15
J18041	731	1992	MOTR	MXTRC	428ASN4692	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 21.75	\$ 100.15
J18042	731	1992	MOTR	MXTRC	428ASN4734	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 21.75	\$ 100.15
J18043	731	1992	MOTR	MXTRC	428ASN4727	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 21.75	\$ 100.15
J18044	731	1992	MOTR	MXTRC	428ASN4737	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 21.75	\$ 100.15
J18045	731	1992	MOTR	MXTRC	428ASN4702	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 133.95	\$ 212.35
J18046	731	1992	MOTR	MXTRC	428ASN4729	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 21.75	\$ 100.15
J18047	731	1992	MOTR	MXTRC	428ASN4736	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 21.75	\$ 100.15
J18048	731	1992	MOTR	MXTRC	428ASN4691	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 21.75	\$ 100.15
J18049	731	1992	MOTR	MXTRC	428ASN4718	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 21.75	\$ 100.15

J18050	741	1992	MOTR	MXTRC	428ASN4715	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 21.75	\$ 100.15
J18051	741	1992	MOTR	MXTRC	428ASN4699	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 21.75	\$ 100.15
J18052	741	1992	MOTR	MXTRC	428ASN4731	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 21.75	\$ 100.15
J18053	741	1992	MOTR	MXTRC	428ASN4693	C	\$ 9.80	\$.00	\$ 9.80	\$ 78.40	\$ 170.30	\$ 248.70
J18255	780	1992	MOTR	MXTRC	428ASN4939	C	\$.00	\$.00	\$.00	\$.00	\$ 21.75	\$ 21.75
J18256	780	1992	MOTR	MXTRC	428ASN4923	C	\$.00	\$.00	\$.00	\$.00	\$ 21.75	\$ 21.75
J18257	780	1992	MOTR	MXTRC	428ASN5051	C	\$.00	\$.00	\$.00	\$.00	\$ 21.75	\$ 21.75

TOTAL CATEGORY 862 RADIO - MOBILE - LOW BAND							\$ 2394.20	\$.00	\$ 2394.20	\$ 19153.60	\$ 9668.75	\$ 28822.35
TOTAL DISTRICT 7							\$ 2394.20	\$.00	\$ 2394.20	\$ 19153.60	\$ 9668.75	\$ 28822.35
REPORT TOTAL							\$ 2394.20	\$.00	\$ 2394.20	\$ 19153.60	\$ 9668.75	\$ 28822.35

*** END OF REPORT ***

FIGURE 5 Example of radio cost report.

MMIS430 MMIG4335 MMIR434
05/24/94 143257

ILLINOIS DEPARTMENT OF TRANSPORTATION
BUREAU OF MAINTENANCE
SUMMARY OF RADIO LIFE TO DATE
REPAIR FREQUENCIES AND COSTS
DISTRICT 7
EFFECTIVE 05/24/94

PAGE: 2

--EQUIPMENT DESCRIPTION--			-----REPAIR ACTIITY-----								
YEAR MAKE MODEL	NUMBER UNITS		REMOVALS	INSTALLS	PM/INSP.	RECEIVER	SCANNER	TRANSMITTER	POWER SUPPLY	OTHER	ALL REPAIRS
CATEGORY : 862 RADIO - MOBILE - LOW AND											
1992 MOTR MRTRC	25										
NUMBER OF REPAIRS			3	3	0	0	0	0	0	27	33
TOTAL COST (\$)			109	336	0	0	0	0	0	640	1085
AVG COSTOF REPAIR (\$)			36	112	0	0	0	0	0	23	32
1992 MOTR MXTRC	231										
NUMBER OF REPAIRS			9	20	1	0	0	0	0	247	277
TOTAL COST (\$)			327	2247	32	0	0	0	0	5976	8582
AVG COSTOF REPAIR (\$)			36	112	32	0	0	0	0	24	30
CATEGORY : 862 RADIO - MOBILE - LOW BAND											
NUMBER OF REPAIRS			12	23	1	0	0	0	0	274	310
TOTAL COST (\$)			436	2584	32	0	0	0	0	6616	9668
AVG COST OF REPAIR (\$)			36	112	32	0	0	0	0	24	31

*** END OF REPORT ***

FIGURE 6 Example of radio cost summary report.

WARRANTY TRACKING

During development of the radio management system, the Department was in the midst of upgrading much of its mobile radio fleet. All new equipment was purchased with a 12-month warranty for parts and labor from the manufacturer. Since new equipment was installed of a period of several months, it became important to track and notify radio coordinators and the maintenance contractor when new equipment was nearing the end of the warranty period to add it to the maintenance contract. A specific report was created to project warranty exportations 60 days before the end of warranty. This report not only aids the radio coordinators, it also helps to track warranty expirations on all types of vehicles and equipment monitored by the MMI System (See Figure 3).

CROSS REFERENCING TO MEET USERS NEEDS

Traditionally the Department has assigned simple coded radio call signs to either the vehicle or the individual assigned a two-way mobile radio. These "on-air" call numbers are well established and are frequently memorized by operators and dispatchers. Each mobile radio also carries a unique Department inventory control

number used to track the item within the inventory systems. New radios have programmable digital identifiers that allow selective signaling and interrogation of the radio from the control console. All these codes have some meaning to various people associated with the use, management and control of the radio system. Therefore, each is made a part of the master inventory record for each radio. The need to cross reference these unique codes became an obvious report to include in the radio management program. The report can be produced in three sorts: inventory number, call number and I.D. number (See Figure 4).

COST OF OPERATION

As with other equipment, tracking and knowing the ongoing operating cost of operating and maintaining the radio system was the number one objective in formulating the radio management module of the MMI System. Since all payments originate with the central offices, district radio coordinators had no solid understanding of the cost of the system under their control. Costs beyond contract costs for removals, installs and modifications could easily get out of control. The local coordinators could not track the cost and was not responsible for controlling the budget. The cost

tracking report shown in Figure 5 provides local and state coordinators and managers with cost tracking for the most recent month and year to date. This allows the local coordinator to know the impact of the fixed and above contract expenditures, and to control costs that might otherwise go unchecked.

NATURE OF REPAIRS

In purchasing new mobile radio equipment for a large part of its operation the Department expects to reduce the overall cost of operating the radio system and improve the reliability of radio service for routine and emergency operations. In previously developed equipment management report systems, an effort was made to categorize and track the frequency and cost of repairs for products from different manufacturers. This categorized tracking approach has been adapted for the radio management system. Figure 6 shows the general layout for reporting the nature and cost of various radio repairs.

CONCLUSION

Two-way communication is a vital link for the day-to-day operation of the Department and other state DOTs. The future will likely produce even more dependence on radio transmission of voice and data to meet the ongoing needs of transportation agencies. The Department has come to realize two-way radio management is not secondary to the management of the vehicle and equipment fleet. It is an integral part of the management process. To this end the Department has integrated radio system management into the total maintenance management program and is training personnel to optimize the use of the various records and reports. This system is in its infancy. No specific results can yet be attributed to its implementation. However, the application of fundamentals learned in the seven years of using and refining the total system prompt belief that this too will be a successful and well-used tool in day to day operations management.