

CANADIAN EVALUATION FUSION VERSUS SINGLE-SOURCE:

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ABSTRACT

The Canadian Media Directors' Council (CMDC) undertook this comprehensive fusion evaluation with the cooperation of four Canadian media survey organizations, Print Measurement Bureau (PMB), the Newspaper Advertising Databank (NADbank), Bureau of Broadcast Measurement (BBM) and A. C. Nielsen. Between them these four audience measurement organizations cover magazines, daily newspapers, radio and TV.

Among these surveys, three are single source (media and product data). The test was unique in simultaneously testing fusion for all three surveys, each acting as both the donor and the recipient, using two different data integration techniques – MultiBasing developed by Telmar of New York and fusion as proposed by SM Research of Toronto in conjunction with IMMEDIATE, a software subsidiary of Czaia Marktforschung of Bremen.

This paper documents the test design and scope of the project, concluding with the PMB analysis that examines the extent to which the media / product usage relationships found in its original single source database are preserved through each of fusion and MultiBasing.

The PMB findings show that neither integration technique succeeded in fully replicating the original single source relationships. However, the findings also suggest that where single-source data are *not* available, both techniques succeed, to some extent, in predicting them.

BACKGROUND

The project was initiated by the CMDC in 2003 to address the issue of duplication of product data in single source media surveys in Canada. Each of PMB, NADbank and BBM Radio Return-to-sample (RTS) include substantial product data, of which it was estimated that 75% was common to the three surveys

Contents of single source media surveys in Canada

	Primary medium	Other media	Demographics	Product	Attitudes / Psychographics
PMB	Magazines	Yes	Yes	Yes	Yes
BBM – Radio RTS	Radio	Yes	Yes	Yes	Yes
NADbank	Dailies	Yes	Yes	Yes	Yes

From the CMDC perspective, there were several problems with this degree of overlap. First, there is the cost issue : someone has to pay, and in the end it is the advertiser. The CMDC initiative was designed to bring about cost savings benefiting all parties in the advertising process. A second cost issue was the personnel and training implications incurred by ad agencies to manage competing surveys using different software tools. Finally, it is not surprising to find that each survey has somewhat different question techniques. There are hundreds of examples, but just one makes the point. All three surveys have questions on incidence and frequency of business travel. However, there are differences in definitions, time periods and scales. Inevitably these differences lead to different results.

Business Travel Questions

<p>PMB</p> <p>Business travel over 80 km one way: Any business trips in past 3 years?</p> <ul style="list-style-type: none"> ▪ Yes ▪ No <p>Number of business trips past 12 months?</p> <table style="width: 100%;"> <tr> <td>▪ None</td> <td>▪ 6 – 8</td> </tr> <tr> <td>▪ 1</td> <td>▪ 9 – 11</td> </tr> <tr> <td>▪ 2</td> <td>▪ 12 - 14</td> </tr> <tr> <td>▪ 3</td> <td>▪ 15 - 20</td> </tr> <tr> <td>▪ 4</td> <td>▪ 21 +</td> </tr> <tr> <td>▪ 5</td> <td></td> </tr> </table>	▪ None	▪ 6 – 8	▪ 1	▪ 9 – 11	▪ 2	▪ 12 - 14	▪ 3	▪ 15 - 20	▪ 4	▪ 21 +	▪ 5		<p>BBM RTS</p> <p>In the past 12 months, which airline(s) have you flown on for business reasons (16 airlines and 'other' listed).</p> <ul style="list-style-type: none"> ▪ Have not flown ▪ Have flown <p>Number of business trips past 12 months (list of airlines).</p> <ul style="list-style-type: none"> ▪ One trip ▪ Two trips ▪ Three trips ▪ Four trips ▪ Five trips ▪ Six or more
▪ None	▪ 6 – 8												
▪ 1	▪ 9 – 11												
▪ 2	▪ 12 - 14												
▪ 3	▪ 15 - 20												
▪ 4	▪ 21 +												
▪ 5													
<p>NADbank</p> <p>Business travel to another city (includes day trips and / or overnight). Business trips taken in past 12 months?</p> <ul style="list-style-type: none"> ▪ Yes ▪ No <p>Number of business trips taken in past 12 months?</p> <table style="width: 100%;"> <tr> <td>▪ 1</td> <td>▪ 2 – 5</td> <td>▪ 6 - 11</td> </tr> <tr> <td>▪ 12 - 19</td> <td>▪ 20 - 29</td> <td>▪ 30 or more</td> </tr> </table>		▪ 1	▪ 2 – 5	▪ 6 - 11	▪ 12 - 19	▪ 20 - 29	▪ 30 or more						
▪ 1	▪ 2 – 5	▪ 6 - 11											
▪ 12 - 19	▪ 20 - 29	▪ 30 or more											

SOLUTION - HUB SURVEY CONCEPT

The CMDC proposed to address these issues using the concept of a hub survey that links its product data to various satellite media surveys using common demographics. The plan envisaged two hub surveys :

- One providing national market information suitable for network TV, national newspapers and magazines,
- One providing local market information suitable for local market radio and daily newspapers.

An important aspect of this design is that it would leave the currency measures intact. Media data would continue to be collected by the existing media survey. However, the product data would be collected only by one survey, and fused to the other surveys, reducing unnecessary duplication and costs.

Obviously this would not answer questions about multi-media reach and frequency. While there were certainly advocates for going the additional step of including media in the fusion, this test was designed to go one step at a time.

TEST DESIGN

The Request for Proposal process resulted in two suppliers selected to do a test using Toronto media data collected in 2001 / 2002 by five media measurement organizations:

- PMB
- BBM Television
- BBM Radio RTS
- NADbank
- A.C. Nielsen TV

The two selected suppliers were Czaia Marktforschung (Bremen) in collaboration with SM Research who proposed a fusion process, and Telmar who proposed using their proprietary MultiBasing software integration method, announced in the 2001 International Readership Symposium in Venice. (1)

Six fusions to be tested : Among the five media organizations, three surveys (PMB, BBM Radio RTS and NADbank) collect both media and product data. This meant that each of those three surveys had two potential fusions to evaluate :

- PMB would evaluate the concept of becoming a recipient for product data provided by NADbank or BBM Radio RTS.
- NADbank would evaluate the concept of becoming a recipient for product data provided by PMB or BBM Radio RTS.
- BBM Radio RTS would evaluate the concept of becoming a recipient for product data provided by NADbank or PMB.

Importantly, in all the above linkages, the fused or MultiBased result is compared with the original single source data. We believe that, in testing three single source surveys at once, this study has a comprehensiveness that is unprecedented in the history of media / product fusions.

Samples – The Toronto sample for each of the three surveys was between 4,000 and 5,000 respondents. The sample structures were different in each case, designed to work best for the media concerned. Briefly,

- The PMB sample is a disproportionate probability sample achieved via face to face interviewing at home followed by a self-completed product booklet.
- The NADbank readership sample is generated by telephone using random digit dialing, with respondents then mailed a product booklet.
- The BBM Radio RTS has two distinct phases. First there is telephone recruitment for a one-week radio diary using random digit dialing. Those completing the radio diary are later mailed a return-to-sample product questionnaire.

These sample differences were of course well understood in advance of this fusion test. The test was designed to evaluate the success of data integration despite these real life difficulties.

Products / Demographics to be analyzed : The analysis focused on a list of products which had both sufficient sample sizes for analysis when cross tabulated by media, and where the questions and overall usage levels were reasonably consistent across the three surveys. Each measurement company selected product categories leading to an initial total of 34 product categories. Ensuring each product had consistent questions and usage levels across all three studies reduced the available product list to seven product categories representing a broad cross section of products as shown in the table below. Each product was analyzed on 12 demographics, also selected to ensure comparability across the three surveys.

Products analyzed	Demographic groups analyzed
Travel Outside Canada	Three age groups
Mortgage	Three education groups
Lottery Tickets	Three occupation groups
Banking (Royal Bank)	Three income groups
Tennis	
Women's Clothing (The Bay)	
Attend movies 1 / month	

Criteria : Each of the three single source data providers, PMB, BBM Radio RTS and NADbank did their own analysis of the resulting fusions. It was agreed in advance the objective was to answer this key question :

“In the absence of our own single source product data, can we accept as replacement comparable product data imported from the donor study?”

This paper reports PMB’s assessment of replacing its own single source data with data imported from NADbank or BBM Radio RTS, via fusion or MultiBasing.

PMB ANALYSIS

PMB’s test design envisaged 5 analyses, grouped as below. This structure starts with the least rigorous, and proceeds to the most rigorous. The sequence of ascending rigor is patterned after the taxonomy for evaluating the validity of fusions proposed in the ARF’s 2003 Guidelines for Data Integration (2), based on Susanne Raessler’s “*Statistical Matching : A Frequentist Theory*” (3).

1. Individual magazine title readership among product users	
a. Stability of data (within ± 10%)	Exhibit 1
b. Number of statistically significant differences	2
c. “Top 10” analysis.....	3
2. Selectivity analysis using index of product usage among readers	
a. Stability of selectivity index.....	4
b. Cohort analysis.....	5

PMB’s analysis is based on all 40 magazine titles measured, cross-tabulated vs. all the available products listed above. Cross tabulations were done twice, once based on all persons and a second time using a selected demographic sub-group, (eg younger age group for movies, high income group for banking). In this way the data were analyzed on demographics that were relevant in advertising terms, with sufficient sample sizes, across the full list of titles.

1. MAGAZINE READERSHIP AMONG PRODUCT USERS

1 (a) Stability of readership levels among users : A rough but telling measure of how well the data integration has worked is to determine whether the readership levels among product users are maintained reasonably closely to their original PMB value. We chose a criterion of plus or minus 10%, because this level corresponds to market place expectations. Fusion met this criterion in 246 cases out of 560. MultiBasing did not achieve the same level as fusion, with 199 cases out of 560 lying within ± 10% of the original value.

Number of cases where individual magazine readership among product users is maintained within ±10%

Donor data	Number of cases examined	After Fusion to PMB	After MultiBasing to PMB
BBM RTS	280	119	101
NADbank	280	127	98
Total	560	246	199

Note also that on this measure, there were no material differences between BBM RTS and NADbank as donors.

1 (b) Statistically significant differences : This same pattern appears when the differences are examined for statistical significance. Out of the 560 cases examined, in 95 cases, the magazine readership levels among product users were significantly different after fusion, compared with 142 cases for MultiBasing.

Number of cases where, after data integration, individual magazine readership among product users shows a statistically significant difference (95% confidence interval)

Donor data	Number of cases examined	After Fusion	After MultiBasing
BBM RTS	280	47	85
NADbank	280	48	57
Total	560	95	142

While this analysis showed a definite advantage for fusion relative to MultiBasing, we would not consider this particular test conclusive. The problem with counting cases of statistical significance is that in many instances, it involves cases that are relatively unimportant.

Regarding the two potential donor databases, on this measure, MultiBasing produced more statistically significant changes with BBM RTS as a source. Fusion showed no differences between BBM RTS and NADbank as donors.

1 (c) Top 10 analysis - The “Top 10 analysis” was designed to provide information about the extent to which the set of magazines in the top 10 buying list would remain constant pre and post data integration. This analysis therefore looks at the top 10 as determined by the readership level among product users in the original PMB survey, and examines how many remain in the top 10 after data integration using either fusion or MultiBasing.

Both techniques performed satisfactorily in this regard. Each averaged 8 out of 10 across the product categories and demographic categories examined.

Note re. MultiBasing II: At this point, the reader will note the presence of an additional column of data labeled MultiBasing II. In the course of the execution of the CMDC test, Telmar introduced an upgraded software package, MultiBasing II. For timing reasons it was only possible to include the upgraded software for the BBM RTS data integration analysis. However its inclusion, even on this limited scale, gives insight into the advantages available through this later release. MultiBasing II also averaged 8 out of 10.

Average number of magazine titles remaining in the top 10 after data integration

Donor data	After Fusion	After MultiBasing I	After MultiBasing II
BBM RTS	8	8	8
NADbank	8	8	Not available

2. SELECTIVITY ANALYSES

What we have termed “Selectivity” measures the degree to which the readers of an individual magazine title are more or less highly correlated with product users. In media fusions, preservation of the selectivity index is considered highly relevant to the acceptance and utility of the results, (M. Brown “*Effective Print Media Measurement*” [4]).

Users of PMB data also consider this is a key evaluative measure. Publications that have higher indices are likely to be more efficient vehicles for reaching targeted product users. Finding these relationships is a benefit for ad agencies seeking the most efficient vehicles, and for their clients whose ads will be most efficiently placed.

2. (a) Stability of Selectivity Index

For the above reasons, this analysis concentrates on the magazines with the highest selectivity index for each product. In the original PMB database the magazines were ranked by their selectivity index, and those in the top quintile (8 out of 40) were examined to find how the index was affected by data integration.

Average product usage index for the top quintile of magazine titles

Donor data	Original PMB	Post fusion	Post Multi Basing I	Post MultiBasing II
BBM RTS	168	129	107	121
NADbank	149	129	112	N/A
Average	159	129	110	121

In the original single source PMB database, the top quintile of titles had an average selectivity index of 159. This implies that, on average, these titles included 59% more product users than would be found in the general population. The above table shows that fusion replicated about one-half of that selectivity index, significantly outperforming MultiBasing I in this respect. MultiBasing II showed improvement relative to MultiBasing I, without fully closing the gap relative to fusion. Once again, on this measure, there were no material differences between BBM RTS and NADbank as a potential donor.

These fusion findings are directionally similar to findings reported by MRI in 2005. The ability to produce only a fraction of the relationship between the product users and the media is a predictable consequence of the fact that the fusion is working on common demographics and, while demography is a strong predictor of consumer behaviour, MRI’s study found demographic predictors “often fail to replicate a single source measure”. (5)

A similar point is made by Susanne Raessler and KarlHeinz Fleischer in their 1998 paper “*Aspects Concerning Data Fusion Techniques*”, where they clarify the need for variables to be uncorrelated for fusion to reproduce them. (6)

2 (b) Cohort analysis - The Cohort analysis examined whether the publications comprising the top quintile maintain their competitive advantage vs. other titles. The selectivity index for the top quintile is compared to that for the middle quintile in the table below.

Average product usage index for the top quintile of magazine titles vs. middle quintile

	Original PMB	Post fusion	Post MultiBasing I	Post MultiBasing II
Top quintile average selectivity index	159	129	110	121
Middle quintile	111	107	102	112
Relative advantage : Top vs. middle	+ 48	+ 22	+ 8	+ 9

The publications comprising the top quintile had on average an index of 159 in the original single source PMB data, giving them a relative advantage of 48 points versus the publications in the middle group with an index of 111. This relative advantage dropped to 22 after fusion and to 8 and 9 for MultiBasing I and MultiBasing II respectively.

CONCLUSIONS

This was a comprehensive evaluation, examining results obtained via data linkage to the original single source database. Using five increasingly rigorous criteria it examined different data linkage techniques, different potential donors, across a variety of products and demographic groups. It resulted in valuable learning for future data linkage exercises with guidance about both the techniques and potential donors:

1. Neither of the two data integration techniques succeeded in replicating the degree of correlation between magazine readers and product usage to the extent that existed in the original single source survey.
2. However, in the absence of single source data, the data linkage techniques could have a role, as they replicated at least partially the correlations found in the original single source survey.
3. The fusion technique succeeded in replicating about half of the selectivity index in the product categories tested, significantly outperforming MultiBasing I. MultiBasing II demonstrated improvement in this respect without fully matching fusion.
4. Regarding differences between BBM Radio RTS vs. NADbank as a potential donor for data integration, there were no consistent differences in any of the validity measures relating to which one of these was the donor. We conclude that, between these two, the choice of donor would depend on other criteria such as sample size and representivity, response rates and question content.

FURTHER LEARNING - TV

The three single source databases, PMB, NadBank and BBM RTS were also linked to TV via both fusion and MultiBasing. However, because of the absence of a single source benchmark for TV, these linkages could not be included in the analysis described above. While full results are not available at this time, PMB has nevertheless reviewed some of the findings from the perspective of a data owner with responsibility to ensure transmission of product information with minimum distortion onto the recipient TV database. One finding is clear : MultiBasing performed as designed in preserving exactly the PMB product data incidence levels.

References

1. *MultiBasing – Data Integration without Regression to the Mean* Peter Walsh, Telmar Group / Harris Media Systems – 2001 Readership Symposium
2. ARF Guidelines for Data Integration – 2003
3. Susanne Rässler : *Statistical Matching : A Frequentist Theory, Practical Applications and Alternative Bayesian Approaches*. Springer-Verlag, New York
4. M. Brown : *Effective Print Measurement* 1999
5. *Clearing the confusion surrounding Media Data Fusion* – Julian Baim, Media Post December 2005
6. *Aspects Concerning Data Fusion Techniques* – Susanne Raessler and KarlHeinz Fleischer, Zuma Nachrichten Spezial August 1998

Exhibit 1 - Fusing BBM RTS and NADbank data to PMB**Stability of readership levels among product users
Number of cases within $\pm 10\%$ of original**

Note re. labels:
MB1 indicates MultiBasing I
MB 2 indicates MultiBasing II

BBM RTS product data linked to PMB	Total	Number of cases in range 90-110	
	Cases	After fusion	After MB I
Travel Outside Canada – All 12+	40	25	31
Top Income (HHI \$75K+)	40	21	17
Have Mortgage – All 12+	40	26	22
High Occupation (Mgr +)	40	25	18
Lottery Tickets (\$20+/month) – All 12+	40	9	6
Mid Education (College/some Univ)	40	7	6
Royal Bank - Main Banking – All 12+			
High Occupation (Mgr +)	40	6	1
Total	280	119	101

NADbank product data linked to PMB

Have Mortgage – All 18+	40	22	20
Top Education (Degree/Post Grad)	40	16	12
Movies 1+/month – All 18+	40	27	18
Adults 18 - 34	40	19	13
Tennis - Regular/Occasional – All 18+	40	5	8
The Bay - Women's Clothing – All 18+	40	23	16
Royal Bank - Main Banking – All 18+	40	15	11
Total	280	127	98

Exhibit 2 - Fusing BBM RTS and NADbank data to PMB

**Preservation of product usage levels by title
Number of significant differences**

BBM RTS product data linked to PMB	# Sig.Diff.		
	Cases	After Fusion	After MB I
Travel Outside Canada – All 12+	40	4	6
Top Income (HHI \$75K+)	40	1	10
Have Mortgage – All 12+	40	2	7
High Occupation (Mgr +)	40	6	11
Lottery Tickets (\$20+/month) – All 12+	40	14	15
Mid Education (College/some Univ)	40	8	12
Royal Bank - Main Banking			
High Occupation (Mgr +)	40	12	24
Total	280	47	85

NADbank product data linked to PMB

Have Mortgage – All 18+	40	7	6
Top Education (Degree/Post Grad)	40	12	14
Movies 1+/month – All 18+	40	6	7
Adults 18 - 34	40	0	2
Tennis - Regular/Occasional – All 18+	40	16	13
The Bay - Women's Clothing – All 18+	40	3	7
Royal Bank - Main Banking – All 18+	40	4	8
Total	280	48	57

Exhibit 3 - Fusing BBM RTS and NADbank data to PMB - Top 10 analysis

BBM RTS product data linked to PMB	# magazines remaining in Top 10		
	After fusion	After MB I	After MB II
Travel Outside Canada – All 12+	9	9	9
Top Income (HHI \$75K+)	10	8	8
Have Mortgage – All 12+	8	10	8
High Occupation (Mgr +)	9	10	8
Lottery Tickets (\$20+/month) – All 12+	8	8	7
Mid Education (College/some Univ)	7	7	6
Royal Bank - Main Banking – All 12+			
High Occupation (Mgr +)	7	7	8
Average	8	8	8

NADbank product data linked to PMB		
	After fusion	After MB I
Have Mortgage – All 18+	10	9
Top Education (Degree/Post Grad)	7	8
Movies 1+/month – All 18+	9	10
Adults 18 - 34	9	9
Tennis - Regular/Occasional – All 18+	5	6
The Bay - Women's Clothing – All 18+	10	9
Royal Bank - Main Banking – All 18+	9	8
Average	8	8

Exhibit 4 - Fusing BBM RTS and NADbank data to PMB**Selectivity Analysis - Preservation of magazines' selectivity with respect to product users**

	Readership Selectivity Index (avg top 8 magazines - out of 40)			
	PMB	After fusion	After MB I	After MB II
BBM RTS product data linked to PMB				
Travel Outside Canada – All 12+	145	114	113	143
Top Income (HHI \$75K+)	133	134	115	142
Have Mortgage – All 12+	165	152	132	132
High Occupation (Mgr +)	117	114	89	97
Lottery Tickets (\$20+/month) – All 12+	233	145	117	129
Mid Education (College/some Univ)	215	137	98	111
Royal Bank - Main Banking – All 12+				
High Occupation (Mgr +)	171	110	83	90
Average	168	129	107	121

NADbank product data linked to PMB

Have Mortgage – All 18+	159	144	124
Top Education (Degree/Post Grad)	138	109	89
Movies 1+/month – All 18+	133	119	108
Adults 18 - 34	126	115	100
Tennis - Regular/Occasional – All 18+	179	157	108
The Bay - Women's Clothing – All 18+	152	129	149
Royal Bank - Main Banking – All 18+	158	130	107
Average	149	129	112

Exhibit 5 - Fusing BBM RTS and NADbank data to PMB**Cohort Analysis - Preservation of magazines' product usage selectivity relative to the 'middle cohort' of publications**

	PMB Original single source data			After Fusion			After MultiBasing 1			After MultiBasing II		
	Top cohort	Middle cohort	Ratio	Top cohort	Middle cohort	Ratio	Top cohort	Middle cohort	Ratio	Top cohort	Middle cohort	Ratio
BBM RTS product data linked to PMB												
Outside Canada – All 12+	145	111	1.31	114	113	1.01	113	107	1.06	143	118	1.21
Top Income (HHI \$75K+)	133	108	1.23	134	123	1.09	115	101	1.14	142	114	1.25
Mortgage – All 12+	165	119	1.39	152	128	1.19	132	118	1.12	132	133	0.99
High Occupation (Mgr +)	117	93	1.26	114	95	1.20	89	97	0.92	97	104	0.93
Tickets (\$20+/month) – All 12+	233	138	1.69	145	109	1.33	117	106	1.10	129	108	1.19
Education (College/some Univ)	215	108	1.99	137	90	1.52	98	115	0.85	111	126	0.88
Bank - Main Banking												
Occupation (Mgr +)	171	120	1.43	110	91	1.21	83	78	1.06	90	79	1.14
Average	168	114	1.48	129	107	1.21	107	103	1.03	121	112	1.08

NADbank product data linked to PMB

Mortgage – All 18+	159	115	1.38	144	107	1.35	124	110	1.13			
Education (Degree/Post Grad)	138	94	1.47	109	92	1.18	89	84	1.06			
Movies 1+/month – All 18+	133	115	1.16	119	105	1.13	108	103	1.05			
Adults 18 - 34	126	108	1.17	115	99	1.16	100	95	1.05			
Tennis - Regular/Occasional – All 18+	179	95	1.88	157	141	1.11	108	111	0.97			
The Bay - Women's Clothing – All 18+	152	111	1.37	129	113	1.14	149	114	1.31			
Royal Bank - Main Banking – All 18+	158	115	1.37	130	101	1.29	107	96	1.11			
Average	149	108	1.39	129	108	1.19	112	102	1.10			
Overall average	159	111	1.47	129	107	1.20	110	102	1.08	121	112	1.08

