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USING FARMER DECISION–MAKING PROFILES AND MANAGERIAL CAPACITY AS PREDICTORS OF FARM VIABILITY IN ARGENTINEAN DAIRY FARMS (LA PAMPA)

Influencia de la capacidad gerencial del ganadero sobre la viabilidad de granjas lecheras argentinas (La Pampa)

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ABSTRACT

The aim of this study was to evaluate the effect of management on the economic viability of the dairy farms in La Pampa (Argentina). Between 2005 and 2007 the owners/managers of 57 dairy farms were interviewed by stratified randomized sampling with proportional assignation. It was analyzed 22 variables related to the decision–making process, farm features and personal aspects of the farmer/manager were analyzed. The farms were divided into viable or unviable regarding their ability to generate profits. A logistic regression model was used to determine variables related to the viability of the farm and its functioning. Results showed that the farm size (OR=1.006), the compilation of farming records (OR=5.928), the use of external information (OR=5.910) and external advisors (OR=5.738) in the farm decision–making were significant predictors of the farm's viability, being particularly relevant the influence of management on the economic yield of the farm.

Key words: Agribusiness, decision analysis, management.

RESUMEN

El objetivo del estudio fue evaluar el efecto de la gestión sobre la viabilidad económica de explotaciones lecheras en La Pampa (Argentina). Mediante un muestreo aleatorio con asignación proporcional fueron seleccionadas 57 explotaciones. La información se recopiló durante el periodo 2005–2007, mediante entrevistas directas con el productor/gestor y visitas a las explotaciones. Se analizaron 22 variables relacionadas con el proceso de toma de decisiones, características de la explotación y aspectos personales del productor/gestor. Las explotaciones fueron clasificadas como viables o inviables de acuerdo a su capacidad para generar beneficios. Se utilizó un modelo de regresión logística para determinar y cuantificar las variables que expliquen la viabilidad económica. Los resultados mostraron que la superficie de la explotación (OR=1,006), el registro periódico de información interna de la empresa (OR=5,928), el uso de información externa (OR=5,910) y la existencia de asesores (OR=5,738) fueron predictores significativos de la viabilidad de la granja. Se pone de manifiesto la especial relevancia de la gestión sobre el rendimiento económico de la actividad.

Palabras clave: Toma de decisiones, gestión empresarial, agronegocio.

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INTRODUCTION

Many studies have identified large differences in the technical and economical performance achieved by farms that operate in the same agrosystem, under similar environmental and economical conditions. For example, in La Pampa (Argentina) during 2006 approximately, 12% of dairy farms earned a negative return on the capital, while 43% of them earned a positive 10% or greater - a range of over 21% [16].

Differences in economic results are usually linked to differences in farm management, which was defined as the fourth production factor [7]. However, management is not directly observable, which hinders analyses aiming to explain its impact on the performance of farms.

Rougoor et al. [28] classified management aspects in two groups: farmer's relative aspects and decision-making as-

pects. The aspects related to the farmers include their goals and motivations, aptitude, skills and biographic facts. Aspects related to decision-making include planning, implementation and control over decisions about the farm. Since farmer aspects influence the ability to make decisions, both components must be taken into account simultaneously in order to accurately evaluate management [28]. Furthermore, including other aspects such as the farm structure or the production system, improve the representation of the human component over the agrosystem, as suggested by Solano et al. [31].

Farmer aspects are the most commonly studied, usually by a production frontier approach, most notably the biographic facts such as education level or the farmer's age [18, 25, 32]. Other studies have also tackled the impact of the goals and motivations of the farmer on the results of the dairy farm [4] and the effect of their skills and capacity [24]. Decision–making process has been less studied and together with the personal aspects of the farmer have only been rarely examined. An example is the study conducted by Wilson et al. [36] on wheat farms in Eastern England and the one by Solano et al. [31] on dairy farms in Costa Rica.

Different studies show that management plays an important role in the performance of the farm, and in other aspects such as the technological advancement or management practices [3]. However, empirical evidence regarding the impact of the different management elements can only be used in the specific environment from which it was collected. Any management aspect can vary with a change in the agrosystem, productive specialization, location, socio-economic, political or temporary context. For example, age is one of the aspects most frequently studied and which presents the highest variation in the response. Thus, some studies have shown a positive relationship between the farmer's age and the farm performance [32] while others showed the opposite relationship [25], both negative and positive relationships (since this effect varies according to the district, [2]) or even no relationship [18]. Consequently, in order to improve the performance of any agrosystem is necessary to specifically determine in a particular environment and context what farmer aspects and aspects involved in the decision-making process have significant influence.

Additionally, an important objective of any agricultural policy is to identify the unviable farms and the possibility to make them viable [33]. This is not only important for farmers, but also for banks or creditors who are becoming increasingly interrelated to the primary sector. The large number of studies on business viability conducted in recent years, contrasts the few studies conducted on farms such as the ones by Wadsworth and Bravo-Ureta [34] and Franks [14] which explain and predict the financial health of farms. The viability models are usually constructed including technical, economic and financial aspects of the farm but management aspects are included much less frequently.

Therefore, the aim of this study was to evaluate the impact of management on the viability of dairy farms in La Pampa (Argentina).

MATERIAL AND METHODS

The study area is the dairy belt of La Pampa Province in Argentina, which is composed of 172 dairy farms and a census of 26,408 milking cows distributed in eight departments [19]. The study area is located between meridians 63° and 65° West and paralells 35° and 39° South, covering approximately 32,467 km^2 [11]. The soils, showing a slight slope to the east, and gentle undulations from North to South, are constituted by sandy sediments, ranging from 1m, in the West, to over 6m depth, in the East, without rocky patches [15]. The climate of the area studied is characterized by benign winters and mild summers, with seasonal rains, mainly in the spring. The mean annual precipitation during 1990–2003 was 724 mm and the mean temperature was 15°C [29].

A randomized sampling design, stratified by department, with proportional allocation, was used (0.95 confidence level, 0.1 precision and 0.5 estimated true proportions). The selected sample composed by 57 surveyed farms, constituted a 33% of the studied population. Information was gathered by direct interviews with the farmer or the manager and by direct observations on farms. The technical and economical information was gathered during 2005-2007, using the survey in Giorgis [16]. Information related to management was collected during 2007 by means of a survey based on Rosenberg and Cowen [27]. Since the manager of each farm remained the same during the study period, it is reasonable to assume that the responses related to management received that year can be applied to the entire study period.

From the information gathered, 16 management variables were defined under the hypothesis that they may explain differences in farm viability. The definition of the variables is shown in TABLE I. Four variables were selected to represent the influence of the manager's personal aspects: manager, age, experience and education. The manager variable indicates if it is clear which person makes the decisions in the farm. It is mostly related to the necessity of choosing who the survey should be addressed to, more than an attribute related to the management capacity, since it is expected that someone makes the decisions. A value of 1 was given to this variable if it was clearly established who makes the decisions and 0 when this was not clear or there were differences or disagreements. Age, experience and education variables define biographic aspects of the manager. The first two were numerically codified corresponding to the age of the manager and his years of experience, while the latter one was given a value of 1 if the manager has completed an advance degree or 0 otherwise.

TABLE I
DEFINITION OF VARIABLES HYPOTHESISED AS INFLUENCING VIABILITY OF FARMS

Variable	Definition
Manager	Dummy variable=1 if is well defined who makes decisions and 0 otherwise
Age	Manager age
Experience	No. of years of managerial experience
Education	Dummy variable=1 if decision maker has had some form of higher education (diploma, degree, etc.)
Selection	Dummy variable=1 Rationality in process leading to employee hiring decision
Assessment	Dummy variable=1 Objectivity of criteria used in the evaluation of employee performance
Feedback	Dummy variable=1 Regularity of communication with employee about job performance
Information	Number of sources of information that the manager regularly uses
Record	Dummy variable=1 If technical and economic data are periodically recorded, in an organized manner
Advisers	Dummy variable=1 If periodic external advisers are available (veterinarian, economist, etc.)
Dedication	Consulting hours *per* month
Record use	Dummy variable=1 If records are used formally
Information use	Dummy variable=1 If external information is used formally
Objectives	Dummy variable=1 There is a clear definition of objectives and goals of farm
Planning	Dummy variable=1 There is a clear and consistent planning with corporate objectives
Evaluation	Dummy variable=1 If the technical and economic results of the company are regularly assesses
Surface	Total area of each farm (ha)
Capital	Total investment excluding land ($)
Stoking rate	LU / ha
Indebtedness	Own capital / permanent stand
Diversification	income from milk sales / total income of the business
System	Group to which the farm is assigned according to Giorgis (2009) typology

Due to the importance of the performance of the workers on the economic yield of a business, the influence of the human resources management was considered. The managers were asked to describe the personnel selection process, the performance evaluation of the workers, and whether the workers knew what their manager's opinion about their performance was. Responses were categorized after the completion of the interviews. The *selection* variable gives information about the formality of the personnel selection process, and values of 0 were given if selection was made based on emotional aspects or if there was no selection due to the fact that the business was strictly family-based; values of 1 were given if there was a rational selection process. The *assessment* variable indicates objectivity in the manager's process of performance evaluation of the workers. When the assessment was based in general observations or the workers were evaluated in a casual manner (e.g "I sometimes visit the barn"), the *assessment* variable was given a 0. If the manager mentioned any sort of structured and regular system or a system based on objective assessment (e.g. Somatic cells counts), a value of 1 was given. The *feedback* variable gives information about communication between the manager and the workers about the performance of the workers. A value of 1 was given if the manager kvlewed regularly any aspect of their performance with the workers and a value of 0 if this never o rarely happend.

The influence of decision–making process was studied through nine variables representing three aspects: information accessed by the manager, manager's use of the information and the formality of the process. The information accessed by the manager was studied through the following variables: *information*, *record*, *advisers* and *dedication*. The *information* variable indicates how accessible external information about the business is (e.g. internet access, specialized publications, etc) and was given a number indicating the amount of sources consulted regularly by the manager. The *record* variable indicates the accessibility to internal business information and was codified as 1 if data were recorded in an organized manner (e.g. number of cows that fails to being in heat, milk prices, etc) and as 0 if they were not. Regarding professional advice, two aspects were considered: use and frequency. The *advisers* variable was given a 1 if the business had at least 1 external advisor and a 0 if there were no adviser or there was

rare consultation. The *dedication* variable indicates advising frequency and was given a number indicating the number of hours per month that the adviser dedicated to the business.

Regarding the use of information, managers were asked to classify it in each of the provided sources. Their answers were categorized upon completion of the interview. The *record use* variable indicates the formal use of the archives. A value of 1 was given if the manager mentioned regularly using some of the archives in the planning of the business and 0 if this was not mentioned or he made only occasional use (e.g. when billing decreases). The *information use* variable, which represents the formal use of external information sources was codified in a similar manner. The formality of the decision–making process was evaluated according to three aspects: *objective*, *planning* and *evaluation*. The managers were asked to describe the goals of their business, their ongoing plans and whether they knew if their plans work. The *objective* variable was given a 0 if the objectives were not clear or was difficult to express them or 1 if they were clearly defined. The *planning* variable indicates whether there are ongoing plans coherent with the objectives of the previous variable. A value of 0 was given if there were no plans or they were not in line with the goals of the business and 1 if they were. The *evaluation* variable, indicates the objectivity in the assessment procedure used by the manager to evaluate the outcome of his plans. When the assessment is done either casually or based on general observations a value of 0 was given. If he mentioned an structured system and based in objective archives a 1 was given.

Additionally, the influence of the following farm's aspects was considered: size, production system, intensification, diversification and *indebtedness*. Except for the *system* variable, the rest were codified as the means for the 2005-2007 period for each farm. Overall, the variation among years within farms was very small. Farm size was represented by the *surface (farm total hectares)*; *intensification* was represented by *stocking rate;* diversification was represented by the proportion of the income from milk sales representing the total income of the business, a*nd indebtedness was evaluated as the proportion that the own capital supposes on permanent stand*. The *system* variable indicates the group to which the farms belongs to, according to the typology established by Giorgis [16] which is composed by the following categories. System 1: Contains 27.6% of farms and it is characterized by high dairy specialization and small size. System 2: Large family farms, focused on cattle fattening and dairy with low productivity (17% of farms). System 3: Small family farms with high specialization on dairy (27.6% of farms). System 4: Represented by 10.6% of farms, characterized by a very large size, high diversification, and non-family business. System 5: Non-family farms covering a large surface and characterized by high technology and high specialization on dairy production (12.7% of farms).

A logistic regression model was used to detect variables explaining with a higher probability the viability of the farm and to determine its functioning [20]. *Farm viability* was used as the dependent variable, and a value of 1 was given if it was viable or 0 if it was not. The criterion to classify a farm as viable or unviable was its capacity to generate enough profit to pay for the alternative use of the family labor and the land property. To reduce the variability in the economic yield caused by random effects, such as natural phenomena, the dependent variable was defined for a three year period in agreement with Cordts et al. [8]. A farm is considered viable if the profit generated during 2005–2007 is higher than the one that could be obtained by leasing the land and with alternative employment of family labor in the same region. The reference values for the leasing of the land and the remuneration of family labor were yearly published by the La Pampa government [17]. As independent variables were used those with the highest discriminatory power, established by a t–test for independent samples in metric variables and a chi–square test for the non-metric variables. The overall model significance, was determined by the likelihood ratio, and goodness of fitting, through the test of Pearson. All statistical analyses were performed in SPSS, version 14.

RESULTS AND DISCUSSION

Fifty eight percent of the analyzed businesses were classified as viable, while the other 42% were not viable in the long-term. TABLE II shows the statistical description of the studied variables and their influence on viability. Most of these variables (12 out of 22 significantly affect the viability of the business), show the importance of management on the economic profit of the business.

Notably, in 59.6% of the farms it was not clearly defined the person in charge to make decisions. These cases belong to family businesses in which there is not an external manager and many of the decisions are translated into the family context, a practice that it is very common in this type of businesses as shown by Maseda et al. [23] for dairy farms in Spain. As expected, when it is clear who makes the decisions, there is an increase in the economic success probability, while if there are contradictions or disagreements, there is a decrease (P=0.006). As family structure is predominant on the farms of the region, the fact that farmers does not take business decisions within the family context may be a high impact measure.

According to Bravo–Ureta and Pinheiro [6] and Wang et al. [35] it expected that managers with a higher education degree can make better decisions and, consequently, their farms must be more viable. The results of this study confirm this suggestion (P=0.002).

Experience and farmer's age are two commonly studied aspects but also very controversial. It is expected that more experienced farmers will make better decisions and that will positively affects the performance of the farm [32, 35]. Sometimes age has a negative effect, possibly due to more difficulty

TABLE II

MEASURES OF VARIABLES HYPOTHESISED AS INFLUENCING VIABILITY OF FARMS (MEAN ± STANDARD ERROR IN QUANTITATIVE VARIABLES, RELATIVE FREQUENCY IN QUALITATIVE VARIABLES)

Variable	mean ± s.e. / %	Inviable farms	Viable farms	P
Manager				0.006
Well defined (1)	40.4	23.5	76.5	
Otherwise (0)	59.6	69.6	30.4	
Age	51.08 ± 1.76	50.57 ± 2.35	50.75 ± 2.80	0.961
Experience	18.15 ± 1.93	16.78 ± 2.10	21.78 ± 2.21	0.714
Education				0.002
Higher education (1)	64.9	21.6	78.4	
Otherwise (0)	35.1	80.0	20.0	
Selection				0.071
Rationality (1)	15.8	44.5	55.6	
Otherwise (0)	84.2	41.7	58.3	
Assessment				0.000
Objetivity (1)	43.9	12.0	88.0	
Otherwise (0)	56.1	65.6	34.4	
Feedback				0.000
Regularity (1)	29.8	5.9	94.1	
Otherwise (0)	70.2	57.5	42.5	
Information	3.16 ± 1.76	2.96 ± 2.16	3.36 ± 2.34	0.321
Record				0.000
There are periodic records (1)	47.4	14.8	88.2	
Otherwise (0)	52.6	66.7	33.3	
Advisers				0.012
There is periodic consulting (1)	57.9	27.3	72.7	
Otherwise (0)	42.1	62.5	37.5	
Dedication	8.43 ± 2.32	8.19 ± 4.68	8.67 ± 4.21	0.542
Record use				
Formally used (1)	38.6	4.5	95.4	0.006
Otherwise (0)	61.4	65.7	34.3	
Information use				0.000
Formally used (1)	29.8	11.8	88.2	
Otherwise (0)	70.2	55.0	45.0	
Objectives				0.004
Clearly defined (1)	49.1	10.7	89.3	
Otherwise (0)	50.9	72.4	27.6	
Planning				0.017
Consistent with the objectives (1)	42.1	16.7	83.3	
Otherwise (0)	57.9	60.6	39.3	
Evaluation				0.031
Objetivity (1)	26.3	26.7	73.3	
Otherwise (0)	73.7	47.6	52.4	
Surface (ha)	221.6 ± 21.02	194.6 ± 26.27	342.4 ± 34.87	0.014
Capital ($)	364640 ± 89574	260162 ± 45431	309198 ± 46163	0.462
Stoking rate (LU/ha)	0.91 ± 0.06	0.61 ± 0.07	0.72 ± 0.06	0.365
Indebtedness (%)	16.36 ± 2.43	17.8 ± 3.7	15.4 ± 3.2	0.676
Diversification (%)	68.73 ± 3.18	67.0 ± 4.3	72.7 ± 4.6	0.378
System				0.276
Intermediate dairy (1)	28.0	43.7	56.3	
Diversified family (2)	17.5	80.0	20.0	
Family dairy (3)	29.8	70.6	29.4	
Diversified business (4)	12.3	42.8	57.2	
Commercial dairy (5)	12.3	57.1	42.9	

for some farmers to make investments, renew machinery or develop changes in the management at a certain threshold [34]. The results of this study show that neither experience nor age affect viability of the La Pampa dairy farms.

Notably, only 15.8% of the managers/farmers describe a formal process to select their personnel based on structured interviews or performance of practical tasks. This is explained by the fact that farms are mostly family farms (76%) [16]. There, all the hand labor is conducted by family members, and consequently the manager/farmer has little choice of selection. However, when the manager could decide, the most common selection criterion was the recommendation by other workers. In this study have not been found any relationship between the viability of the farm and the formality of the personnel selection process.

Rosenberg and Cowen [27] studied the human resource management in California dairy farms, under the assumption that the objective evaluations of job performance with regular communication about it with employees improve the results, although they found no evidence to support this hypothesis. Results of this study showed that 43.9% of the managers/farmers systematically assessed the performance of their employees in an objective manner; the milkers receive extra attention since they are usually external workers and because of the high economic importance of the task they perform. However, only 29.8% of the managers/farmers gave regular feed–back to them regularly. A positive relationship between those two variables and the farm viability was present (TABLE II).

The information in the agropecuary businesses can be generated in the business itself, through systematic registries or it can originate from external sources and from advisers. Some studies (e.g. Wilson et al. [36]) have shown positive relationships between both consulting and access to external information sources, and the economic yield of the business. If the manager/farmer does not have appropriate information on a regular base, the efficacy of decisions will be highly at random. Although the results of this study did not show significant differences for repercusion of time that consulting agents dedicate to the business or the number of external information sources regularly consulted, they showed that systematic registry of internal information and regular access to consulting agents were both crucial for the viability of dairy farms in La Pampa (TABLE II). The mere fact of registering data can be the origin of decisions which, even if they do not follow a formal procedure, might be efficient for the business [30].

Otherwise, the use of external information by the manager/farmer was associated to the viability of the farm ($P<0.000$). Thus, 88.2% of the businesses that regularly use external information in the business' planning were classified as viable, while 55% of the unviable farms did not make use of it. Other studies such as Cowen et al. [9] and Kiernan and Heinrichs [21] have shown similar results regarding the information use. Likewise, the use of technical and economical registries of the farm by the manager/farmer during planning (in particular those related to reproduction and feeding) was also associated to viability ($P=0.006$).

About a half (49.1%) of farmers/managers, clearly established the objectives and goals of the business; 42.1 % of them mentioned implementation of actions coherent with those, and 26.3% mentioned some kind of system, structured and periodic, based on objective registries, to evaluate the performance of their functioning. Those three variables were significantly associated to the viability of the farm (TABLE II).

Regarding aspects related to the farm and the production system, only size was significantly associated with viability ($P=0.014$); which can be attributed to the development of economies of scale. In larger farms, technical advances and innovations can be more easily applied, and so, reach a larger production level which allows for an ever decreasing cost per unit. This is in agreement with the findings by Wilson et al. [36] in British wheat farms.

Giorgis [16] identified five dairy production systems in La Pampa, differing mainly in their size, diversification, technology, intensification and family involvement in the business. Although some of those aspects confer competitive advantages favoring viability, results showed that the system type alone was not a determinant factor in the success of the farm.

According to Allen and Lueck [1], farms with a certain level of diversification are more viable due to their lower susceptibility to market fluctuations and meteorology. Lines and Zulauf [22] showed a similar relationship between viability and indebtedness level. However, in the present study no differences were found regarding either of those aspects.

In TABLE III the results of the logistic regression are shown. Only the variables: *surface*, *record*, *information use* and *advisors* were significant predictors of the viability of the farm. The model correctly predicts 83% of the studied cases, which is considered satisfactory according to Jiménez and Aldás [20]. The overall significance of the model was tested using the test of maximum likelihood, which had a value of 29.98 with four degrees of freedom ($P<0.000$). A Pearson test was used to test the goodness of the fit, which was 43.04 for 40 degrees of freedom ($P=0.384$), which indicates an adequate degree of predictability.

Remarkably, the best prediction model was determined by variables related to the type and use of information made by the manager/farmer and the farm size. Size increases viability probability by 1.006 folds per additional hectare. Systematic internal information gathering increases by 5.928 folds the probability of success. The use of external information in the decision making process leads to a 5.910 folds increase in success probability. If the business has regular advice, the probability of success is 5.738 folds higher, independently to whether the advising is permanent or not. Farm with the three management indicators have a success probability 201 times higher.

TABLE III
LOGISTIC REGRESSION ANALYSIS TO ESTIMATE ADJUSTED ODDS–RATIO FOR VIABILITY IN DAIRY FARMS OF LA PAMPA (*N* = 57)

Explicative variables	Coefficient	Standard error β	Wald $\times^2$	Freedom degrees	P	Odds ratio (95% IC)
Intercept	-5.905	2.272	6.754	1	1,333	
Surface	0.006	0.004	2.259	1	0,009	1,006 (0,99-1,01)
Record	1.780	0.993	3.213	1	0,007	5,928 (0,85-41,50)
Information use	1.777	1.349	1.734	1	0,012	5,910 (0,42-83,16)
Advisers	1.747	1.283	1.854	1	0,034	5,738 (0,46-70,94)
	Test		$\times^2$	Freedom degrees	P	
Model evaluation						
Likelihood ratio			29.989	4	0.000	
Goodness of fit						
Pearson			43.042	40	0.384	
Cases correctly classified (%)			85.4%			

Previous studies investigating economic viability of farms have encountered difficulties defining good indicators. In this study the definition of viability has followed the approach marked by Fennell [12], who indicated that mainly the cessation of farming is a consequence of its inability to generate long-term benefits. Likewise, Foster and Rauser [13] and Brangeon et al. [5] used a similar concept. Although the viability indicator used in this study may not be a formal value for accounting, it shows the economic unviability of agropecuary farms with more objectivity than other indicators based on financial or accounting ratios. For example, suspension of payments, as proposed by Davies [10], occurs very rarely after a lengthy process, because the producer tries to avoid it by means of selling assets, reducing inventories, or going to work outside the farm. Other studies have used the delay in payment of loans, but ignore the farm potential for solve the situation [26]. In addition, farmers tend to mix the family finances and farm finances, which is an added disadvantage for these indicators.

In general, models that have attempted to explain and predict the economic viability of farms have been based on technical and economic-financial aspects, considering less frequently biographical aspects of farmer [14, 34]. In this study, the best prediction model has been constructed with variables related to information and its use by the manager/farmer along with the farm's surface. As the management aspects have provided more meaningful information than other aspects considered, it is likely that their inclusion in feasibility models developed in other agricultural systems, can improve its explanatory and predictive quality.

CONCLUSIONS

The farm size, the compilation of farming records, the use of external information and external advisors in the farm decision-making were significant predictors of the farm's viability, being particularly relevant the influence of management on the economic yield of the farm. The fact that the decision making at the farm is produced by a manager with upper studies promotes the economic performance of milk production. The economic viability is also favored by the rationality of the decision making process: planning according to clear objectives, the existence of an evaluation method, and the use of records, consultants and sources of information.

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