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Contents

Impact of Business Coalition on Agricultural Policy: A Case Study of the Effect of Sugar Industry Coalition on Sugar Policy in Thailand[*]

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Organized interests play an influential role in public policies in developing countries. Using a case study of the politics of financial assistance in Thailand's sugar sector, this paper examines how coalitions in an agricultural industry affect the government's decision to transfer resources to or from the agricultural sector. In particular, the author argues that, when the sugar industry is able to coalesce, the government is more likely to increase financial assistance to the sector. The findings indicate that an industry coalition has an influence on the government's policies. This implies that a coalition in an agricultural industry is able to dominate the government's policy.

Keywords: coalition, sugar industry, agricultural policy, Thailand

Organized interests play an influential role in agricultural policy-making in several developing countries. They can pressure the government to abandon taxes and subsidize them via financial assistance programs. Although scholars (Anderson, 2009; Bates, 1981, 1997; Krueger, 1991; Varshney, 1995) have examined the influence of organized interests in agricultural policies, there is a minimal amount of empirical knowledge regarding the effect of coalitions of organized interests on agricultural policies. Because it is very important to understand how coalitions of organized interests influence public policies such as agricultural policies, affecting people's everyday life in developing societies, this paper examines how players at the sector level affect the government's decision to transfer resources to or from agriculture. We argue that the government is likely to transfer public resources to the sector when members of the agricultural industry coalitions highly coordinate.[1] Politicians are likely to increase subsidy programs to appeal to the industry for their political support.

The second section reviews the relation between organized interests and agriculture. The third section briefly introduces Thailand's sugar sector. The fourth section provides the main arguments and hypothesis. The hypothesis is that, when sugar millers, the most powerful industry in the sugar sector, coalesce or coordinate,

[1] "Coalition of sugar millers" refers to the effort of the millers to collaborate with each other to protect their business interests and represent the businesses' general opinions regarding the state's agricultural policies. It is made possible by an agreement among the industry in which the government regulates its sector too intrusively.

the government is more likely to transfer public revenues to the sugar sector. The fifth section presents dependent and independent variables and the data used in this article. The sixth section provides methods used in the empirical examination. The seventh section presents the statistical results. When sugar millers highly coordinate, the government is likely to increase subsidies in the sugar sector. The eighth section discusses the results in terms of the reason why the millers have an impact on the sugar policy, and concludes the paper.

Governments, Organized Interests and Agricultural Policies in Developing Countries

In several developing countries, the state heavily controls agricultural policies and intervenes in the commodity markets. The government imposes taxes on agriculture more than on other economic sectors to accrue revenues from agricultural exports. Economic ideology plays an influential role in whether governments in developing countries are likely to impose taxes on agriculture. If policy-makers in developing countries are influenced by import-substitution industrialization (ISI)[2], the government is more likely to impose taxes on agriculture. To promote industrialization and protect domestic industry via trade and financial policy, ISI-oriented governments are likely to intervene in the agricultural sector by setting high tariff rates for imported goods, keeping farmers' earnings and food prices low, and taxing all types of exported agricultural commodities (Bates, 1981; Krueger, 1991; Lin, 2009). These policies favor high- and middle-income consumers, whereas the urban poor and rural farmers are left vulnerable to the high prices of staple foods (Lal, 1985; Lipton, 1977).

Agricultural businesses are able to influence the government to generate policies they prefer, nonetheless. First, governments in several developing countries subsidize particular agricultural industries so that they can sufficiently supply commodities to the domestic market and reduce commodity imports (Binswanger & Deininger, 1997). Second, the industries are able to pressure the government to set the price for their commodities above the global market prices (Krueger, 1991). Third, the government allows representatives of these industries and farmers to participate in policy-making whereas it impedes or limits the participation of other industries or farmers. Although scholars (e.g., Bates, 1981, 1989; Kasara, 2007; Krueger, 1991; Varshney, 1995) recognize the power of organized interests in agricultural policies, they rarely examine internal factors—coalitions of agricultural industries—that make particular agricultural industries more powerful and influential than others. In other words, they often have overlooked how coalitions of agricultural industries affect the government's policies.

Agricultural industries act collectively because they want to put more effective pressure on the government to implement policies that are favorable to their interests. They expect the government to implement policies that increase their income or benefits. Interest group theorists suggest that organized interests join a coalition because they want to pressure the government to reduce taxes and increase subsidies (Becker, 1983; Hojnacki, 1997). In a developing country, the government imposes heavy taxes on agricultural commodities because agricultural exports are the major source of income. Agricultural businesses are affected by the government taxes. They thus have an incentive to coalesce when the government heavily imposes more

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[2] Import-substitution industrialization (ISI) is, basically, defined as state intervention in the process of industrial development by subsidizing newly established industries through loans and funds and implementing protective policies against foreign-competing capital. ISI was widely implemented in several developing countries until the late 1970s. Influenced by the liberal elites, nationalists and urban middle class, Latin American countries were the first developing countries to adopt ISI policies. After World War II, several developing countries in Asia and then Africa adopted ISI to accelerate the growth of domestic industries. For a brief history of the ISI regime in Latin America and its political and social effects, see Williamson (1992).

taxes on their businesses or strictly controls their production and trade.

Whether agricultural industries coalesce depends on how the businesses perceive the government's policies. Some government policies lead to coalition in an agricultural industry because the majority of the businesses oppose the government's control or restriction. The businesses do not want the government to control the sector. Agricultural businesses are likely to coalesce or to collaborate when they perceive that the government regulates their commodity market too intrusively. Agricultural businesses expect that when they coalesce, they can better pressure the government to reduce taxes and increase subsidies. We argue that the coalition of an agricultural industry is likely to lead to an increase in subsidies to the sector.

To examine whether and how agricultural industries can affect the government's decision to transfer public resources to their sector, we explore the question of whether the coalition of the sugar industry in Thailand can affect the government's financial policy for the sugar sector.

The Thai Sugar Sector

Thailand has supported the sugar sector financially for more than 40 years. From the 1960s to the early 1970s, authoritarian governments heavily protected the sugar industry via a set of policies. First, the governments banned the import of foreign-refined sugar in order to protect sugar millers and growers from foreign competition (Doner & Ramsay, 2004). Second, the governments subsidized the millers and growers via price policy. They employed a "home-price scheme", which set domestic sugar prices above export prices (Siamwalla & Setboonsarng, 1987). The millers and growers were protected from fluctuation of sugar prices in global markets. From 1973 to 1975, the elected government had to decrease its financial assistance to the sugar millers due to the sharp decline of sugar prices in the global market and budget constraint (Doner, 2009; Warr & Kohpaiboon, 2009).

In 1984, the semi-democratic government established the Cane and Sugar Board (CSB), which allowed bureaucrats, sugar millers, and sugarcane growers to control sugar production and sales (Siamwalla et al., 1994). Financial assistance to the sugar sector via the CSB continued during the 1990s. Elected governments continued to provide financial assistance to the sugar industry and sugarcane growers. The elected government had to decrease its financial assistance to the sugar sector after the 1997 financial crisis.

Figure 1 shows the evolution of the financial assistance to the sugar sector (i.e., the nominal rate of assistance [NRA]) over time. The average NRA percentage for the sector is 18.23.[3] During the 1970s, the NRA for sugar fluctuated because the government had to reduce financial assistance to the sector due to the fall of sugar prices in global market and budget constraint. Nonetheless, the increase of the NRA percentage in 1976 and 1977 and from 1984 to 1996 indicates that sugar industry could pressure the government to continue financing the sector. From 1984 to 1997, the average of the NRA for the sugar sector was about 34 percent. This rate was almost twice the amount that the government (on average) transferred to the sector from 1970 to 2004 (18.23 percent). It was almost six times the amount that the government (on average) transferred to the sector from 1970 to 1983 (5.85 percent).

In sum, sugar millers tried to play an influential role in the government's sugar policy. The government heavily imposed taxes on the sugar sector during 1970-1983, when sugar millers were not well-organized. Meanwhile, it increasingly financed the sector during 1984-2004, when the millers coordinated.

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[3] See Table A1 in the Appendix.
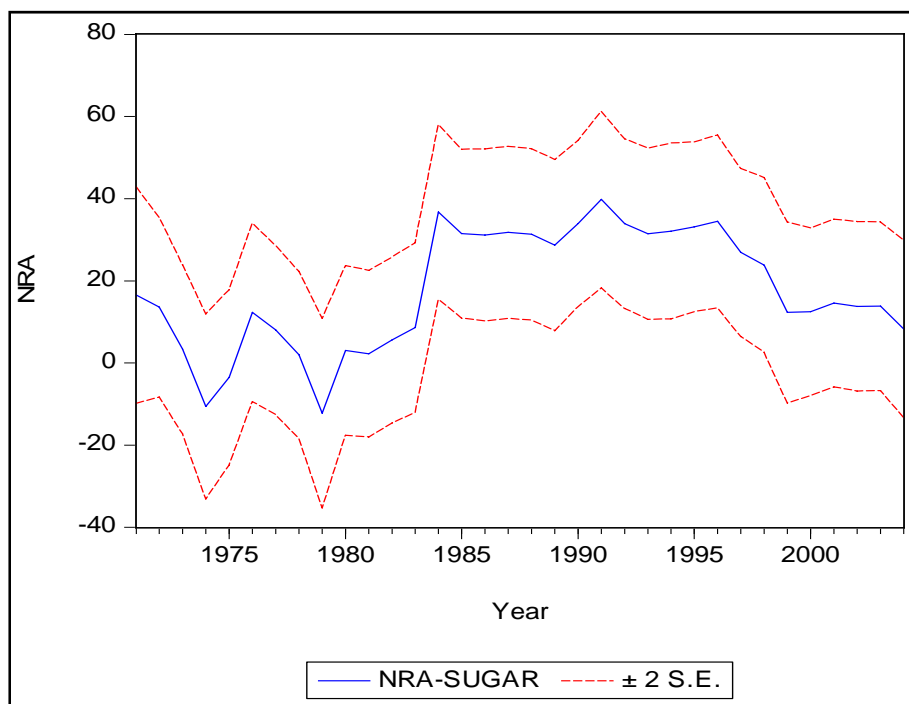
Figure 1. NRA to Sugar, Thailand, 1970-2004.

Hypothesis

We argue that the government is more likely to allocate revenues to the sugar sector, when sugar millers, the most powerful industry in the Thai sugar sector, are increasingly coordinated. The millers are more likely to collaborate with each other, when the government regulates sugar exports too intrusively. They have tried to pressure the government to liberalize the sugar market (Siamwalla et al., 1994). From 1984 to the present, the government heavily intervened in the sugar sector by controlling sugar prices and regulating sugar exports via the three-quota system.[4] The system restrains the millers from exporting raw and refined sugar freely. The millers tried to pressure and lobby the government to liberalize sugar exports during these years (Siamwalla et al., 1994).

In contrast, the millers are less likely to collaborate with each other due to internal conflict regarding the government's production controls. These programs often promote internal conflict among the millers because some are likely to free-ride and overproduce sugar, illegally selling it in the black market or smuggling it to neighboring countries. From 1970 to 1983, the government controlled sugar production by imposing production quotas on each sugar miller (Siamwalla & Setboonsarng, 1987). Some millers overproduced sugar and illegally released it without reporting it to the government (Doner, 2009). There appeared to be no collaboration or trust among the millers. Internal conflict among the millers opened an opportunity for the government to intervene in

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[4] Sugar sales in Thailand are regulated by the three-quota system. First, CSB requires sugar millers to produce and sell Quota "A" sugar only in the domestic market. The millers must transport Quota "A" sugar to the Thai Cane and Sugar Trade Corporation (TCST) to sell to domestic consumers. Second, Quota "B" is the quota of refined white sugar that the CSB requires that sugar millers produce and sell only to foreign markets. The millers do not export Quota "B" sugar themselves but must transport the sugar to the TCST for export. Finally, Quota "C" is the quota of refined white sugar that the CSB allows sugar millers to export after transporting Quotas "A" and "B" to the TCST. The millers do not export the Quota "C" sugar directly. They, instead, export it via the TCST and seven authorized sugar-exporting companies that are actually owned by the millers.

the sugar sector and impose regulation on the industry. We summarize the association between sugar millers and the government's policy in the following hypothesis:

Hypothesis 1: The increase in the NRA for the sugar sector is associated with the coalition of the sugar millers whereas the decrease in the NRA for the sector is associated with the conflict of the millers.

Data

For the empirical analysis, the dependent variable is the NRA for sugar, which captures the annual percentage of the gross returns transferred to or from the sugar sector in Thailand. The unit of analysis is the annual NRA percentage for the sugar sector from 1970 to 2004 (Warr & Kohpaiboon, 2009).

To operationalize and test hypothesis 1, we create the first independent variable: the coalition of sugar millers, which captures the coalition of sugar millers from 1970 to 2004. Sugar millers are likely to coalesce, when the government heavily regulates sugar exports and less likely to coalesce, when the government heavily intervenes in sugar production or sugar prices in the domestic market. The variable is binary: 1 refers to high coordination, while 0 refers to low coordination. The millers were weakly organized during the period from 1970 to 1983, when the government heavily regulated sugar production. In contrast, they coalesced during the period from 1984 to 2004, when the government heavily controlled sugar exports. We expect to find a positive association between the coalition of the sugar millers and the NRA for the sugar sector.[5]

We include the mobilization of sugarcane growers' associations in order to control for the effect of sugarcane growers. The government is likely to increase subsidies in the sugar sector, when the growers are highly and collectively mobilized. Thai sugarcane growers are more organized and mobilized than other farmers. Several sugarcane growers normally join the sugarcane growers' association in order to pressure the government to increase guaranteed prices of sugarcane. During the 1970s, growers began to establish their associations in order to pressure millers to increase sugarcane prices (Nimmanit, 1986). During the 1980s, there was, nonetheless, an internal conflict among the leaders of the growers' associations, which derived from the disagreement over whether the guaranteed prices should be the same prices for all regions (Nimmanit, 1986). During the 1990s, sugarcane growers were highly mobilized. But, in 1991, there was an internal conflict among the leaders of sugarcane grower associations regarding the government's sugar policies (Changsorn, 1991). During 2000-2004, sugarcane growers were likely to mobilize individually due to the disagreement over price guarantee policy. We expect to find a positive association between the mobilization of sugarcane growers and an increase of government's subsidies.

Political regime is included in order to control for the effect of political institutions. We argue that a democratic government is likely to reduce subsidies in agricultural sectors that are previously protected by the authoritarian regime. Under a democratic regime, rural farmers increasingly mobilize to pressure the government to deliver assistance programs to their sectors. In other words, rural farmers compete with each other to pressure the government to allocate resources to them. Despite of the fact that elected politicians want to continue subsidizing these farmers to appeal for their support, they are pressured by other groups of farmers to allocate resources to them. The political regime variable is a continuous variable that captures the characteristics of Thailand's political institutions in terms of whether they are democratic or authoritarian in

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[5] To construct this variable, we consulted the works of Siamwalla and Setboonsarng (1987), Siamwalla et al. (1994), and Doner (2009). Doner (2009) used Thailand's sugar industry as a case study showing the reasons why several developing countries cannot upgrade their industrial sectors and why they cannot become producers and exporters of high-technology commodities.

each year. We rely on the Polity IV's measurement of Thailand's political regimes from 1970 to 2004. The variable ranges from -10 (the most authoritarian regime) to 10 (the most democratic regime).[6] A negative association between political regime and the NRA for the sugar sector is expected.

To control for economic conditions, we use the percentage change in inflation from 1970 to 2004. High and volatile inflation is likely to lead to the government's imposing heavy control on the sugar sector. The government is likely to control food prices, when inflation is increasing. Because sugar is one of the most important inputs for the food and beverage industry, the government is likely to control sugar prices so that food prices will be likely to drop. The Thai government has controlled the prices of retail sugar since 1984 by putting a price ceiling on it. The government's price controls have had a negative impact on sugar millers. The sugar millers have lower incentives to produce sugar so that it is inadequately supplied to the market. In addition, sugar prices sometimes climb because speculators are likely to stockpile sugar.[7] We rely on information from the International Monetary Fund (IMF) regarding the percentage change in Thailand's inflation. Because Thailand's inflation is not normally distributed, we transform it into natural log terms. Inflation is expected to have a negative association with the NRA for the sugar sector.

We use the government's agricultural expenditures to control for the effect of the government's expenditures on agricultural policy. To sustain the growth of sugar exports, the government tends to provide financial incentives for sugar producers (sugar millers and sugarcane growers). It provides sugarcane plantations with assistance loans for sugarcane growers. Sugar millers and sugarcane growers are likely to benefit from a higher percentage share of agricultural expenditures. The agricultural expenditure variable captures the annual percentage share of agricultural expenditures that the government spends on public agricultural programs in rural areas. The percentage share of agricultural expenditures comes from the Bureau of the Budget's annual report. We expect to find a positive association between agricultural expenditures and the NRA for the sugar sector.

To control for the effect of the government's industrial policies, we include the NRA for non-agricultural tradable commodities from 1970 to 2004.[8] Subsidizing industrial sectors has a negative effect on agricultural sectors, including the sugar sector. In protecting domestic industry from foreign producers, the Thai government is likely to set high tariffs. Although high tariffs protect sugar millers from foreign producers, the tariffs have a negative impact on sugar millers and growers. The millers have to import sugar refinery machinery at higher costs, and the growers have to import farm equipment and fertilizer at higher costs. We expect to find a negative association between the NRA for non-agricultural tradable commodities and the NRA for sugar. Table 1 describes the variables' definitions and expectations regarding the coefficient estimates.[9]

Model 1 (a general model) estimates the effects of sugar millers and sugarcane growers with all control variables. In model 2, we exclude the NRA for non-agricultural tradable commodity in order to examine whether or not the millers have more influence on the sugar policy. In model 3, a lagged dependent variable is included to control for the effect of the government's sugar policies in previous years.

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[6] Some years were coded -66 or -88 (transitional or interregnum years). The investigators suggested using 0 to code these years. We follow this suggestion.
[7] For how the government's price control leads to stockpiling staple food and speculating food prices, see Sowell (2007).
[8] For the annual percentage of the NRA for non-agricultural tradable commodities in Thailand, see Warr and Kohpaiboon (2009).
[9] The summary statistics are provided in the Appendix.

Table 1

Description of Variables

Variable	Description	Expectation of coefficient's sign
1. NRA of Thailand's sugar	Gross returns of the government's revenues to (or from) the sugar sector: + = state transferring revenues to sugar; - = state transferring revenues from sugar.	
2. Coalition of sugar millers	High (or low) coordination of sugar millers: 0 = low coordination; 1 = high coordination.	+
3. Farmer unity	High (or low) unity of sugarcane growers: 0 = no unity among the major sugarcane growers' associations; 1 = unity among the major sugarcane growers' associations.	+
4. Political regime	Thailand's political regime: -10 = most autocratic; 10 = most democratic.	-
5. Inflation (log.)	Log. of percentage change of inflation.	-
6. Agricultural expenditures	Annual percentage share of agricultural expenditures.	+
7. NRA of non-agricultural tradable commodities	Gross returns of the government's revenues to (or from) the industrial sector: + = state transferring revenues to non-agricultural tradable; - = state transferring revenues from non-agricultural tradable.	-

Methods

In examining the effects of the sugar industry and sugarcane growers, we employ the ordinary least squares (OLS). We employ mis-specification tests[10] to examine the validity of statistical inferences.

In addressing the robustness of the important variable (i.e., the coordination of sugar millers), we employ extreme bounds analysis (EBA) (Leamer, 1983). The EBA examines whether the statistical inferences are "robust"[11] given changes in the list of control variables (Leamer, 1983). EBA allows us to determine which explanatory variables are robust with respect to the government's decision to transfer resources to or from the sugar sector. The explanatory variables are considered robust, when their parameter estimates show consistently expected results given the changing contexts.

The EBA test process is as follows: we start with a standard OLS model with independent variables and every control variable. Then we randomly exclude and include the control variables, which are questionable in terms of whether they affect the government's revenue transfer decisions. Meanwhile, the sugar industry variable remains in the models. Using this method, we can observe the change in the important variable's coefficient estimates. If the lower extreme bounds of an explanatory variable's estimate are negative while the upper extreme bounds of the variable's estimate are positive, the explanatory variable is less likely to be robust.

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[10] For the tests for serial correlation, see Breusch (1978), Godfrey (1978), Durbin and Watson (1950, 1951). For the test for omitted variable bias, see Ramsey (1969). For the non-normality bias test, see Jarque and Bera (1980). And for the test for heteroskedasticity of errors, see White (1980).

[11] The robustness of the coefficient estimates refers to the consistency of the statistical results. In other words, the estimates are considered robust if the estimates do not change from positive to negative (or negative to positive) terms when circumstances (i.e., the list of control variables) change.

Results

Table 2 shows the effects of the sugar millers' coalition on the NRA for the sugar sector. The adjusted R^2 statistics indicate that models 1, 2, and 3 perform quite well in terms of prediction. The joint F-statistics are statistically significant at $P < 0.01$, which indicates that the explanatory variables jointly have a significant impact on the NRA for sugar.

Table 2

Effect of the Coordination of Sugar Millers on Revenue Transfer to the Sugar Sector

Variable	Model 1	Model 2	Model 3
Coalition of sugar millers	37.70***	38.45***	26.77**
	(10.78)	(5.41)	(10.75)
Farmer unity	7.45*	7.44*	5.59
	(4.33)	(4.05)	(4.02)
Political regime	-1.82**	-1.78***	-1.28*
	(0.73)	(0.50)	(0.70)
Inflation (logged)	0.56	0.49	-0.27
	(2.34)	(2.17)	(2.17)
Agricultural expenditures	3.94**	3.92**	2.93
	(1.84)	(1.79)	(1.73)
NRA for non-agricultural tradable	-0.19		0.02
	(2.30)		(2.10)
NRA for sugar$_{t-1}$			0.34**
			(0.14)
Constant	-34.90	-37.41**	-28.07
	(35.15)	(16.18)	(32.22)
N	34	34	34
Standard error of regression	10.20	10.02	9.32
R^2	0.70	0.70	0.76
Adjusted R^2	0.64	0.65	0.70
F-statistics	10.59***	13.17***	11.79***
Durbin-watson	1.47	1.47	1.95
LM (Lagrange multiplier) (x^2 [1])	0.92	0.89	0.01
RESET (Regression Equation Specification Error Test)	1.10	0.65	0.29
Normality (x^2 [2])	0.98	1.02	1.63
White (x^2 [1])	1.34	1.09	0.84
VIF	5.72	1.69	5.52
AIC (Akaike Information Criterion)	260.60	258.61	255.14
BIC (Bayesian Information Criterion)	271.82	267.76	267.35

Notes. * signifies $P < 0.10$; ** signifies $P < 0.05$; *** signifies $P < 0.01$. Numbers in parentheses are standard errors. In order to determine whether the models are likely to be plagued by the multi-collinearity problem, we employ variance inflation factors (VIF) for the independent variables. In brief, if the value of the VIF is lower than 10, then the models are less likely to be affected by the multi-collinearity problem.

As expected, the coalition of the sugar millers has a positive impact on the government's revenue-transfer. When the sugar millers coalesce or coordinate, the government is more likely to allocate revenues to the sugar sector. Holding other factors constant, when there was collaboration among the sugar industry, the estimated NRA for sugar increased by 37.70 percentage points (i.e., 1 [37.70]). As a result, the estimated NRA for the

sector during the collaboration periods is 37.70 percentage points higher than the average NRA for the sector.[12] In models 2 and 3, the coalition of the sugar millers is also associated with an increase in the NRA for sugar, and its effect is statistically significant. Although an inclusion of a lagged dependent variable reduces the statistical significance of sugar millers' coalition, the variable significantly affects the NRA for sugar at $P <$ 0.05 level, and it shows expected result.

Control variables show some interesting results. The mobilization of sugarcane growers does not consistently show expected results. In models 1 and 2, the growers' mobilization is positively associated with the NRA for sugar sector, and it is statistically significant at $P < 0.10$. In model 3, however, it does not significantly affect the NRA for sugar. The lack of an association between the variable measuring the mobilization of sugarcane growers and the NRA for sugar implies that greater collaboration among sugarcane growers may not necessarily lead to government revenue transfers to the sugar sector, as hypothesized.

Political regime is negatively associated with the NRA for sugar, and it is statistically significant. Holding other factors equal, political regime is associated with a 1.82 percent decrease in the NRA for the sugar sector (see model 1).[13] The results imply that the more democratic the regime is, the more likely the government is to transfer revenues from the sugar sector. Elected governments did not allocate resources to the sugar sector as much as their authoritarian counterparts. From 1980 to 1992 (authoritarian era), the average NRA percentage for the sector is 27, while from 1993 to 2004 (democratic era), the average NRA percentage for the sector is 20. Due to increasing mobilization of other rural farmers and agricultural industries, elected politicians cannot always subsidize particular agricultural sectors such as the sugar sector.

Despite of the fact that its statistical significance decreases, when a lagged dependent variable is included, agricultural expenditure is positively associated with the NRA for sugar. It implies that sugar millers and sugarcane growers are likely to benefit from an increase in the government's agricultural expenditures. Inflation and subsidization of industrial commodities do not appear to have a significant impact on the sugar sector.

Table 2 also shows the F-statistics for the misspecification tests. In model 1, the LM test result for first-order serial correlation is 1.76 (with a P-value of 0.20). The Ramsay RESET result is 1.10 (with a P-value of 0.42). The normality test result is 0.98 (with a P-value of 0.61). White's heteroskedasticity test result is 1.34 (with a P-value of 0.27). The VIF's statistics result is 5.72. Due to the statistical insignificance of the F-statistics, model 1 is not affected by serial correlation, omitted variable bias, heteroskedasticity of standard errors, or multi-collinearity. Similarly, models 2 and 3 are not affected by serial correlation, omitted variable bias, non-normal distribution of residuals, heteroskedasticity of standard errors, or multi-collinearity.

Table 3 provides the results of the EBA. The results indicate that the coalition of sugar miller variable is robust. Its coefficient estimate shows the expected results consistently. The parameter estimate is consistently within the intervals of its extreme bounds. Given the change in political and economic contexts, the estimate always shows a positive term, and it is always statistically significant. The extreme bounds of the coalition of sugar millers range from 22.92 to 50.52. This indicates that a regression of the NRA percentage for the sugar sector with respect to the sugar millers and a combination of some controlling variables yields an estimate of an increase in the NRA in the sugar sector equal to 50.52. It is also possible to find an estimate of 22.92. Anything

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[12] It is based on an assumption that other factors are held constant.

[13] Its statistical significance, nonetheless, decreases when inflation is excluded and a lagged dependent variable is included (see model 3).

between these two extremes can be obtained, but no estimate outside of this interval can be produced no matter how the independent variables of interest are manipulated.

Table 3

The Results of EBA

Variable	Maximum estimate	Coefficient estimate (Model 1)	Minimum estimate
Coalition of sugar millers	50.52 (12.13)	37.70 (10.78)	22.92 (5.01)
	[25.77 to 75.26]	[15.59 to 59.82]	[12.68 to 33.16]

Notes. Numbers in parentheses are standard errors. Numbers in brackets are the 95% confidence intervals.

Discussion and Conclusions

The statistical results show that when the sugar millers highly collaborate, they are able to influence the government to protect them from foreign competition. Four reasons explain why the millers are highly coordinated and unified. First, the industry has few groups of sugar millers. These groups tend to be influenced by a few Sino-Thai families that have been investing in the sugar industry for decades.[14] Second, sugar millers have been well-organized under the Thai Sugar Millers Corporation (TSMC), which coordinates the three sugar miller associations[15] and provides a forum for exchanging opinions, discussing the government's sugar policy, and negotiating with each other. Third, sugar millers tend to be a rather cohesive group, sharing similar interests. Because the sugar-milling industry needs financial and technological support from the government, the millers benefit by collaborating with each other to pressure the government for assistance (Siamwalla et al., 1994). Finally, the millers coalesce and collaborate with each other because they face with powerful collective bargaining of sugarcane growers. Sugarcane growers' associations have increasingly mobilized since 1984 (the establishment of the CSB).[16] Since the growers have more representatives in the CSB than the millers and bureaucrats, they are able to pressure the government and the millers to keep sugarcane prices above the market prices. The millers have an incentive to be unified and organized in order to negotiate with the growers effectively and pressure the government not to comply with every grower's demand.

More importantly, the millers collaborate with each other mainly because the government uses dual sugar policy. On the one hand, the government financially assists the sugar industry via restricting the imports of foreign sugar or reducing business taxes. On the other hand, it heavily regulates the sugar industry. It controls sugar exports through the three-quota system. The government also controls the retail prices of sugar and requires that millers share responsibility for sugarcane plantation assistance loans for sugarcane growers. The millers have pressured the government to abandon price and export controls (i.e., the three-quota system). An

[14] Siamwalla et al. (1994) pointed out that two factors led to the influence of a few sugar millers in the industry. First, investment in sugar milling factories requires a large amount of capital and support from commercial banks. Second, the government does not support the establishment of new sugar milling factories and the expansion of the factories because it is concerned about the long-term financial status of the factories. Also, the existing sugar millers do not want to compete with newcomers.

[15] Three sugar millers' associations are: (1) the Thai Sugar and Bio-energy Producers Association; (2) the Thai Sugar Producers Association; and (3) the Sugar Industry Trade Association.

[16] The strength of sugarcane growers' bargaining power results from the government's sugar policy during 1960s. During these years, the government encouraged the growers to establish and join growers' associations. It expected that growers' associations would have a positive impact on the sugar industry, with millers being able to purchase sugarcane through associations, reducing transaction costs (Siamwalla & Setboonsarng, 1987). Policy-makers expected that the leaders of the growers' associations would encourage their members to do business with sugar millers.

advisor to the TSMC warned that Thailand's sugar industry has been lagging behind that of its competitors (i.e., Australia and Brazil), which have liberalized their sugar markets over the last several years, and argued in favor of abandoning or reforming the revenue-sharing system.[17] The millers try to act collectively in order to pressure the government to maintain protective policies and to abandon some restrictions.

Although the millers have frequently failed to pressure the government to abandon the controls, they successfully pressure the government to keep retail sugar prices at domestic market above the export prices. Figure 2 shows that sugar prices at domestic markets are usually kept above export prices. The sugar price policy indicates the influential role of sugar industry on the government's policy.

Figure 2. Retail and export prices, 1972-2006 (Unit: Bahts per kilogram at current prices). The retail prices are correlated with the export prices at $P < 0.01$ (correlation coefficient = 0.59). Source: Office of the CSB (various years).

To sum up, this paper examines how organized interests such as the sugar industry affect the government's sugar policies (i.e., the NRA for sugar). The argument is that the government is likely to transfer revenues to the sugar sector because the sugar millers highly coalesce and the sugarcane growers are highly unified. The sugar millers collaborate with each other to pressure the government to protect them from foreign producers and to lift some control programs. The sugarcane growers usually join sugarcane growers' associations and unite because they expect that the associations can make effective demands of the government. We hypothesize that highly coordinated sugar millers and highly united sugarcane growers are likely to be associated with an increase of subsidy in sugar sector (i.e., the NRA for sugar).

The statistical results show that, when the sugar millers are highly collaborative, the government is likely to transfer revenues to the sugar sector. The influence of the sugar millers indicates that agricultural industry in Thailand can largely influence sugar policy-making. But, the millers have not been able to pressure the government to abandon some policies such as the third-quota system, which heavily controls sugar export. In

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[17] See Abolishing 70/30 system: Solving sugar industry problems (2001). *The Economic Journal*, November 18, 2001, p. 8.

contrast, the sugarcane growers do not appear to have much influence on the government's sugar policy. The growers cannot influence the government's sugar policy because there is an internal conflict among the sugarcane growers. The guaranteed prices of sugarcane can result in regional conflicts. For example, some sugarcane growers want the government to set the guaranteed prices for their sugarcane higher than those of others. Furthermore, sugarcane growers typically unite and mobilize to demand increases in the guaranteed prices of sugarcane. However, they do not pressure the government to abandon control programs that have a negative effect on the sugar sector. Elected governments are pressured by other agricultural industry groups and rural farmers to allocate revenues to their sector. Under democratic regimes, sugar millers and sugarcane growers have to compete with other agricultural industries and rural farmers to lobby and pressure the government to transfer revenues to their sectors. Despite of the fact that elected governments have reduced financial assistance programs to the sugar sector, they have continued to set the export prices of sugar above the retail prices in the domestic market. Setting the export prices above the retail prices indicates that sugar millers and sugarcane growers can sometimes have an influence on the government's sugar policy-making.

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Appendix

Table A1

Summary Statistic

Variable	Observation	Mean	Standard deviation	Minimum	Maximum
NRA for sugar	35	18.23	16.85	-17	45
Coalition of sugar millers	35	0.60	0.50	0	1
Farmer unity	35	0.51	0.51	0	1
Political regime	35	3.77	4.83	-7	9
Inflation (log.)	34	1.36	0.99	-1.18	3.19
Percentage share of agricultural expenditures	35	8.68	1.16	5.90	11.19
NRA for non-agricultural tradable commodities	35	11.97	3.19	8	16

Environmental Protection Through Sound Air Pollution Control Techniques for the Cement Manufacturing Industry: A Case Study for Zimbabwe

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Technological advancement has resulted in cement-making companies being able to produce higher volumes compared with the past. However the higher production levels have also been largely labeled as the leading cause of pollution. Technological advancement is now being harnessed to curb air pollution in cement-making. The main sources of air pollution in the industry include excavation activities, dumps, tips, conveyer belts, crushing mills and kiln emissions. Harnessing appropriate technology for use in the cement industry could go a long way toward minimising on-site wastes and pollution. It is important to predict air quality because the public is worried about their surroundings that are covered by grey dust. This review examines various options in practice for reducing pollution at cement manufacturing companies, which help ensure legislative compliance. By adoption of appropriate technology and computer modeling, industry will not only reduce production waste but also comply with legislation to do with environmental protection. The purpose of this paper is to come up with equipment and methods of air pollution control. The paper examines certain methods of pollution control used for air and looks at how computer modeling can be adopted for the classification, quantification and control of particulate matter; and how efficient energy use can contribute to better air quality. An analysis of gas stack emissions was done for a cement manufacturing company in Zimbabwe where compliance was investigated. Emissions samples were randomly selected at various points within the company and concentration of various emission constituents was analysed.

Keywords: environment, pollution, emission, particulates

The cement industry contributes significantly to the imbalances of the environment, in particular air quality. The key environmental emissions are nitrogen oxides (NO_x), sulphur dioxide (SO_2) and grey dust (Albeanu, Madsen, Popentiu, & Thyregod, 2004). Industrial plant smokestacks from cement and construction companies are some of the biggest contributors to poor air quality, especially in urban developments. As of

2007, the cement industry alone was reported to produce 5% of total greenhouse gasses in the atmosphere (Air Quality Resources, 2011). The principal aim in pollution control in the cement industry is to minimise the increase at ambient particulate levels by reducing the mass load emitted from the stacks, from fugitive emissions, and from other sources[1]. This paper looks at emission and control of gaseous and particulate matter.

Cement Production Technology

Cement is produced from raw materials such as limestone, chalk, shale, clay, and sand.

These raw materials are quarried, crushed, finely ground, and blended to the correct chemical composition (US Environmental Protection Agency, 2010). Cement is mostly used in mortar and concrete in the construction industry. After the mining, grinding and homogenization of raw materials, the process of the calcination is followed by burning the resulting calcium oxide together with silica, alumina and ferrous oxide at high temperatures to form clinker; the clinker is then ground or milled together with other constituents (such as gypsum, slag, etc.) to produce cement (Karstensen, 2006). The main stages in cement production (see Figure 1) can thus be discussed under the following sub-headings.

Figure 1. Cement production plant (Cement company, Zimbabwe).

Quarrying (Raw Material Acquisition)

Most of the raw materials used are extracted from the earth through mining and quarrying and can be divided into the following groups: lime, silica, alumina, and iron (Albeanu et al., 2004). Limestone (calcium carbonate—$CaCO_3$) is the predominant raw material therefore most plants are situated near a limestone quarry or receive this material from a source via inexpensive transportation. The plant must minimize the transportation cost since one third of the limestone is converted to carbon dioxide (CO_2) during the

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[1] Retrieved from http://cleantechindia.com/eicimage/2102_42/PPACI.htm, 2004.

pyro-processing and is subsequently lost. Quarry operations consist of drilling, blasting, excavating, handling, loading, hauling, crushing, screening, stockpiling, and storing.

Raw Materials Preparation (Raw Milling and Fuels Preparation)

Raw milling involves mixing the extracted raw materials to obtain the correct chemical configuration, and grinding them to achieve the proper particle-size to ensure optimal fuel efficiency in the cement kiln and strength in the final concrete product (Karstensen, 2006). Three types of processes may be used: the dry process, the wet process, or the semidry process. If the dry process is used, the raw materials are dried using impact dryers, drum dryers, paddle-equipped rapid dryers, or air separators, before grinding, or in the grinding process itself. In the wet process, water is added during grinding. In the semidry process, the materials are formed into pellets with the addition of water in a pelletizing device.

Clinker Burning

In the pyro-processing, the raw mix is heated to produce cement clinkers. Clinkers are hard, grey, and spherical nodules with diameters ranging from 0.32 cm to 5.0 cm created from the chemical reactions (sintering) between the raw materials. The pyro-processing system involves three steps: drying or preheating, calcining (a heating process in which calcium oxide is formed), and burning (sintering). The pyro-processing takes place in the burning/kiln department. The raw mix is supplied to the system as a slurry (wet process), a powder (dry process), or as moist pellets (semidry process). All systems use a rotary kiln and contain the burning stage and all or part of the calcining stage. For the wet and dry processes, all pyro-processing operations take place in the rotary kiln, while drying and preheating and some of the calcination is performed outside the kiln on moving grates supplied with hot kiln gases.

Cement Grinding

This stage is also known as finish milling. Here the clinker is ground with other materials (which impart special characteristics to the finished product) into a fine powder. Gypsum and/or natural anhydrite are added to regulate the setting time of the cement. Other chemicals, such as those which regulate fluidity or air entrainment, may also be added. Material that has not been completely ground is sent through the system again.

Cement Packaging and Dispatch

The finished product is transferred using bucket elevators and conveyors to storage silos. Most of the cement is transported to customers in bulk by railway, trucks, and in bags (normally 50 kg bags).

Environmental Impacts of Cement Manufacture

Cement manufacturing is a "high volume process" and correspondingly requires adequate quantities of resources, that is, raw materials, thermal fuels and electrical power. The main environmental (air quality) impacts of the manufacture of cement in general are related to the categories discussed below.

Gaseous Atmospheric Emissions of CO_2, NO_x, SO_2, Volatile Organic Compounds (VOCs) and Others

Carbon dioxide is released during the production of clinker, a component of cement, in which calcium carbonate ($CaCO_3$) is heated in a rotary kiln to induce a series of complex chemical reactions (Conneely, Gibbs, & Soyka, 2001). Specifically, CO_2 is released as a by-product during calcination, which occurs in the upper, cooler end of the kiln, or a precalciner, at temperatures of 600 °C-900 °C, and results in the conversion of carbonates to oxides. The simplified stoichiometric relationship is as follows:

$$CaCO_3 + heat \longrightarrow CaO + CO_2 \qquad (1)$$

Additional air pollutants emitted include such materials as sulphur oxides and nitrogen oxides generated from the kiln and drying processes. Sulphur dioxide is generated from the sulphur compounds in the ores and the combusted fuel and varies in amount produced from plant to plant. The efficiency of particulate control devices is inconclusive as the result of variables such as feed sulphur content, temperature, moisture, and feed chemical composition, in addition to alkali and sulphur content of the raw materials and fuel. The combustion of fuel in rotary cement kilns generates nitrogen oxides from the nitrogen in the fuel and incoming combustion air. The amount emitted depends on several factors including fuel type, nitrogen content, and combustion temperature. Both sulphur dioxide and some of the nitrogen oxide react with the alkaline cement and are removed from the gas stream.

VOCs are a class of chemicals that are emitted directly to the air as a result of evaporation or another type of volatilization. Sources include stored gasoline, stored solvents and other industrial chemicals, and certain industrial processes. Incomplete combustion of fuels of many types is also an important source of VOC discharge to the ambient air. The principal harmful effects of VOCs are toxicity, possible contribution to smog via photochemical reactions in the atmosphere, and possible contribution to the "greenhouse effect" and consequent global warming (Woodard, 2001). Examples are Polychlorinated dibenzodioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) which comprise a family of 210 chemically related organic compounds containing from one to eight chlorine atoms. PCDDs and PCDFs are commonly and colloquially referred to as PCDD/Fs.

Dust

Dust emissions (see Figure 2) originate mainly from the raw mills, the kiln system, the clinker cooler, and the cement mills. A general feature of these process steps is that hot exhaust gas or exhaust air is passing through pulverised material resulting in an intimately dispersed mixture of gas and particulates. The nature of the particulates generated is linked to the source material itself, i.e., raw materials (partly calcined), clinker or cement (Karstensen, 2007). Dust emissions have been linked to respiratory problems such as Tuberculosis.

Figure 2. Emissions from a cement plant.

Bad Odour

Foul smell is sometimes a direct result of the gases emitted during cement manufacturing. Moreover, since cement manufacture has life threatening impacts on plants and animals, the manufacturing process then directly and indirectly gives rise to offensive smells as the dead plants and animals decay.

Environmental Legislation in Zimbabwe

The current constitution of Zimbabwe under section 4 of the Environmental Management Act (EMA) (Chapter 20: 27), in 2002, affords every citizen of Zimbabwe the following environmental rights (Parliament of Zimbabwe, 2000):

(1) The right to live in a clean environment that is not harmful to their health;

(2) Access to environmental information;

(3) The right to protect the environment for the benefit of present and future generations;

(4) The right to participate in the implementation of legislation and policies that prevent pollution, environmental degradation and sustainable management and use of natural resources, while promoting justifiable economic and social development.

Pollution Indicators for World-Class Cement Manufacturers

Table 1 represents PCDD/F stack emissions for the same furnace type but different pollution control technologies for Lafarge Cement Company.

Table 1

PCDD/F Emission Statistics for Lafarge Cement Company

Plant	Filter type	Clinker production (tons per year)	Stack emissions (ng/Nm^3)	Standard regulation
1	Electrostatic precipitator	305,000	0.001	< 0.1
2	Electrostatic precipitator	70,000	0.021	< 0.1
3	Electrostatic precipitator	350,000	0.002	< 0.1
4	Electrostatic precipitator	130,000	0.004	< 0.1
5	Bag house	450,000	0.1714	< 0.1
6	Bag house	500,000	0.231	< 0.1
7	Bag house	250,000	0.0921	< 0.1
8	Wet scrubber	390,000	0.007	< 0.1
9	Wet scrubber	370,000	0.002	< 0.1

Note. Source: Karstensen (2006).

Available Air Pollution Control Technologies and Equipment

Controlling particulate emissions from sources other than the kiln usually entails capturing the dust using a hood or other partial enclosure and transporting it through a series of ducts to the collectors. The type of dust collector used is based on factors such as particle size, dust loading, flow rate, moisture content, and gas temperature. The best disposal method for collected dust is to send it through the kiln creating the clinker. However, if the alkali content of the raw materials is too high, the dust must be discarded, or must be pre-treated before introduction into the kiln. The highest allowable alkali content is 0.6% (as sodium oxide).

Flexible Pulse Jet Filters

Raw gas enters into the filter compartments via inlet ducts equipped with guide vanes that distribute the gas uniformly across the filter bags. This arrangement creates a downward gravimetric gas flow along the filter

bags, precipitating the dust into the hopper below. In contrast to filters where raw gas enters through dampers located in the hoppers, the design of the flexible pulse jet filter gas distribution system prevents the creation of high gas velocities (or vertical, upward gas flow). High gas velocities prevent fine particulate from settling into the hoppers during on-line cleaning cycles. The raw gas is filtered by the fabric from the outside, and the clean gas exits at the top of the bag. The fan is located on the clean gas outlet side of the filter (Alstom, 2011).

Electrostatic Precipitators

Electrostatic precipitators use electrostatic forces to separate the dust from the exhaust gas. By means of discharge electrodes, the dust particles are negatively charged and can be separated on corresponding collecting electrodes. The particles are then discharged from the collecting electrodes to dust hoppers by electrode rapping (Karstensen, 2006).

Wet Scrubbers

In a wet scrubber, the polluted gas stream is brought into contact with the scrubbing liquid, by spraying it with the liquid, by forcing it through a pool of liquid, or by some other contact method, so as to remove the pollutants. Scrubbers can be designed to collect particulate matter and/or gaseous pollutants. Wet scrubbers remove dust particles by capturing them in liquid droplets. Wet scrubbers remove pollutant gases by dissolving or absorbing them into the liquid (Wikipedia, 2011).

Ordinary Bag House Method

This is a filtration method and is one of the oldest and most efficient methods of particulate control (see Figure 3). The most commonly-used filtration device is known as a bag house and consists of fabric bags through which the air stream is directed. Particles become trapped in the fibre mesh on the fabric bags, as well as the filter cake which is subsequently formed (Wikipedia, 2011).
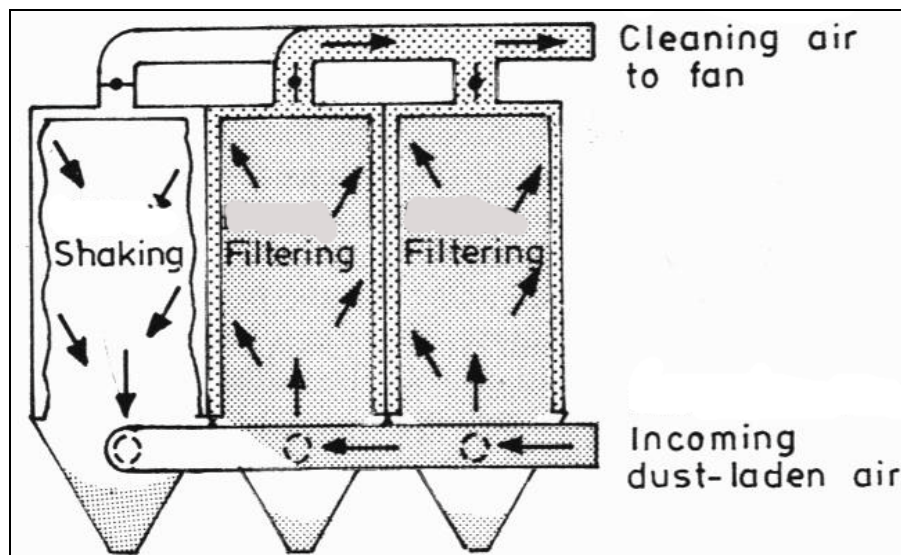
Figure 3. Bag house schematic.

Computer Modeling for Quantification of Carbon Dioxide (CO$_2$) Emissions

Database systems can be taken advantage of, together with Visual Basic applications to quantify or estimate and display CO$_2$ emissions based on composition of the CaCO$_3$ and amounts of lost cement kiln dust.

Estimating emissions generally involves two emission factors: an emission factor for clinker production and an emission factor for cement kiln dust (CKD) production (Conneely et al., 2001).

Clinker Emission Factor

The clinker emission factor is the product of the fraction of lime in the clinker multiplied by the ratio of the mass of CO_2 released per unit of lime. This factor can be estimated as illustrated below (Conneely et al., 2001):

$$EF_{clinker} = fraction\ CaO \times 0.785 \tag{2}$$

The multiplication factor (0.785) is the molecular weight ratio of CO_2 to CaO in the raw material mineral calcite ($CaCO_3$), from which most or all of the CaO in clinker is derived. The result gives the amount of carbon dioxide (in tons) emitted per ton of clinker. Databases and Visual Basic can be used to process and store data and to provide a graphical user interface for monitoring the emissions as production runs. Any deviations above company and legal limits can be easily observed and corrected.

CKD

CO_2 is also emitted during the calcination of CKD in the kiln. CKD is a by-product of the kiln process and a portion of the CKD is placed back in the kiln and incorporated into the clinker. The remaining portion is lost—placed in a landfill or used for other purposes. The lost CKD represents additional CO_2 emissions not accounted for in the clinker emissions estimate. The recommended method to estimate the additional CO_2 emissions from the lost CKD is to multiply an emission factor by the amount of lost CKD. The CO_2 from the lost CKD is generally equivalent to about 2%-6% of the total CO_2 emitted from clinker production (Conneely et al., 2001).

Methodology

Emission measurement was done for sulphur oxides, nitrogen oxides, carbon monoxide, carbon dioxide and gas exit temperature for *X* Cement Company in Zimbabwe Plant. Thermocouples and Opacimeters are the main apparatus that were used to measure/quantify the emissions. Thermocouples were used to measure exit gas temperature whilst opacimeters were used to quantify particulates.

Opacimeter Working Principle

Two types of opacimeters were used online and offline. The basic working principle of an opacimeter (see Figure 4) is that exhaust gas from the chimney is directed into the opacimeter chamber. Opacity is an optical property that refers to the ability to stop light from being transmitted. The basic principle of the opacimeter is that light is emitted from a light source and a sensor some distance away registers the intensity of the light. If a sample with opacity more than 0% is placed in between the light source and the sensor, the measured light intensity will decrease. Through calibration, the measured intensity can be correlated to the opacity of the sample. When there is a perfect transparent matter, e.g., air, the opacity is 0%, and in the opposite case where no light is transmitted, the opacity is 100% (Bodin, 2010).

Thermocouple Working Principle

A thermocouple is a device made by two different wires joined at one end, called the junction end, or measuring end. The two wires are called thermo-elements or legs of the thermocouple. The other end of the thermocouple is called the tail end or reference end. This arrangement is shown in Figure 5. Because of the temperature difference between junction end and tail end, a voltage difference can be measured between the

two thermo-elements at the tail end. Thus, the thermocouple is a temperature-voltage transducer (Scervini, 2009).
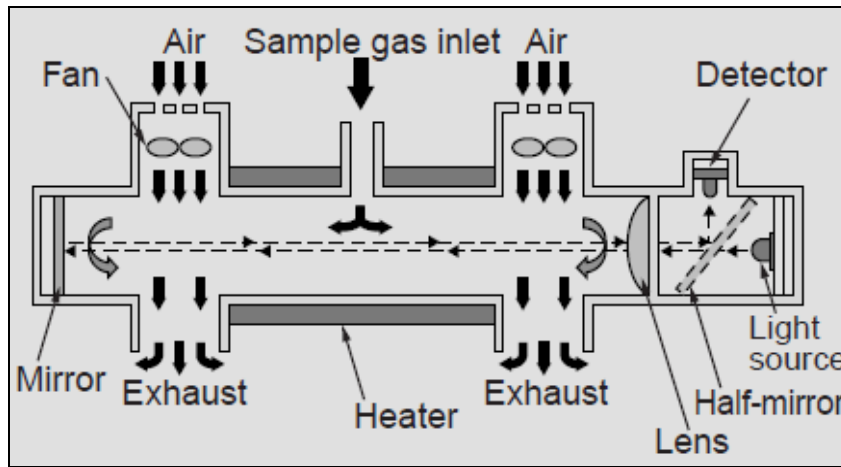
Figure 4. Opacimeter schematic. Source: Kihara (n.d.).
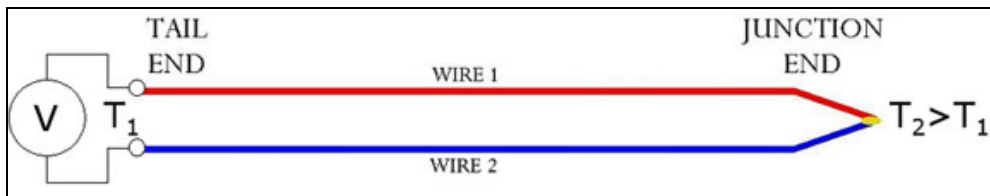
Figure 5. Thermocouple schematic.

Gas Conditioning Towers

Exhaust gases leaving the kiln is at very high temperature which destabilises the ecosystem by killing creatures that cannot survive such high temperature. Hence there is need to cool it down to acceptable temperatures.
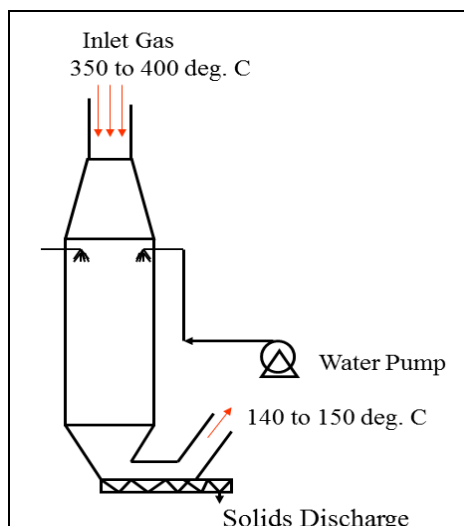
Figure 6. Gas conditioning tower (GCT).

Conditioning towers in the cement industry are used for cooling the exhaust gases from the kiln before it is fed into the precipitators. The exhaust hot gases are fed from the top of gas cooling tower and are cooled by injected water; the gases are drawn through the tower by a fan.

Conditioning towers in the cement industry treat exhaust gases with temperatures between 300 °C and 400 °C, cooling them down to 150 °C (see Figure 6).

Results

From the measurements that were done, sulphur oxides and carbon monoxide were notably out of control relative to the other emissions. The results for these are presented below.

CO Emissions

The emissions recorded in Figure 7 were measured at various points or positions as shown on the graph. However these points are random positions and they are not ordered depending on the distance (actual position) from chimney exit.
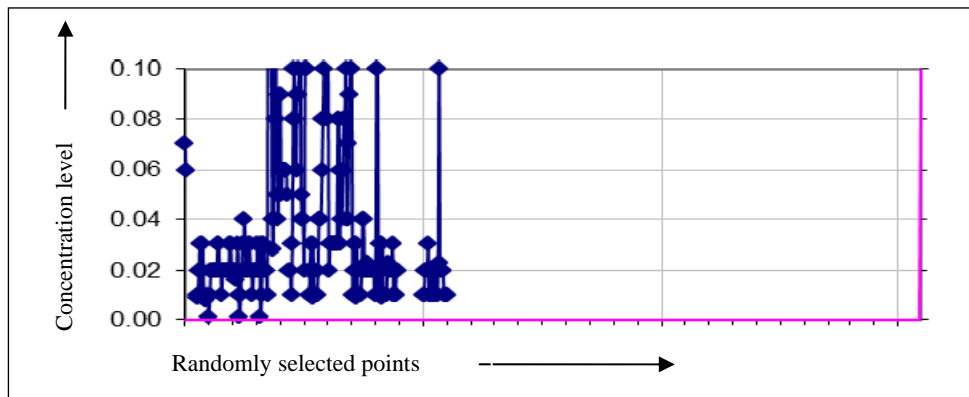
Figure 7. CO emissions (ppm) for *X* Cement in Zimbabwe.

Sulphur Oxides Emissions

After the sampled points (see Figures 8 and 9) have been analysed and are found to be above the required concentration level. The source of emisions is investigated and an appropriate technical solution is recommend. The random sampling can be scheduled and the process becomes continous throughout the life span of the plant.
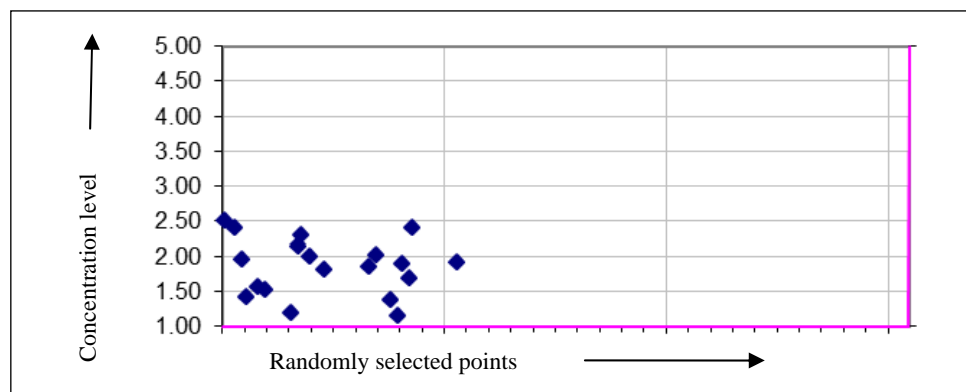
Figure 8. SO$_3$ (%) for stage 4 East.
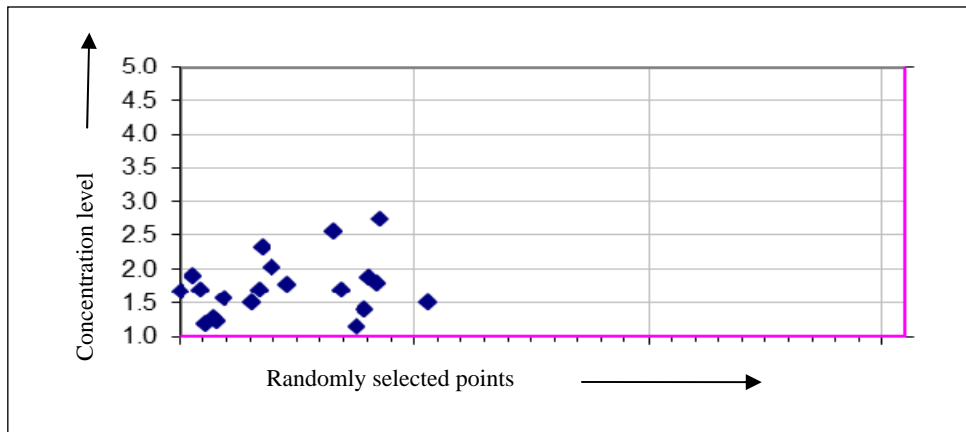
Figure 9. SO$_3$ (%) for stage 4 West.

Figure 10 shows the temperature of flue gases before entering intogas cooling tower and Figure 11 shows the temperature at the outlet of the cooling tower. An analysis of Figure 11 shows that some points have temperaturs well above the recommended range of 140 °C to 150 °C. Hence there is need to investigate such outlet high temperatures possibly by using the fishbone diagrams or other problem-solving techniques.
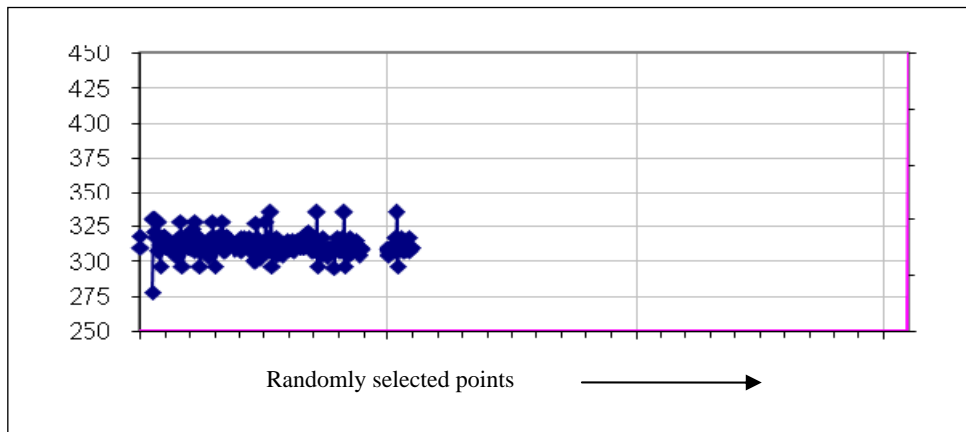
Figure 10. GCT inlet temperature.
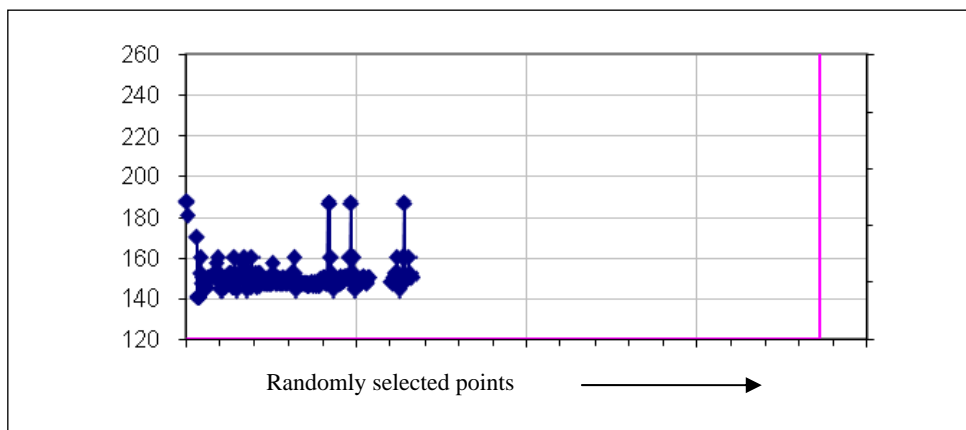
Figure 11. GCT outlet temperature.

Stage by Stage Pollution Control Techniques for Cement Industry

The various techniques that can be used to control pollution in the cement manufacturing process which can be easily identified by considering the major process stages as outlined below.

Raw materials acquisition and handling. During raw material acquisition, the primary air pollutant emitted is particulate matter. Particulate matter is emitted from the quarrying, handling, loading, unloading, and transport of raw materials. The following methods are used to control particulate emissions generated from the quarry and handling of raw materials:

(1) Fabric filters (pulse-jet or reverse-air/shaker);

(2) Equipment enclosures;

(3) Water sprays to suppress dust;

(4) Mechanical collectors;

(5) Chemical dust suppressants;

(6) Paving (where possible).

Dust that is collected by these means is restored to the process. This therefore means that the Reduce, Reuse, Recycle and Recover (4Rs) techniques can be employed to minimise and manage waste during raw materials acquisition.

Clinkerisation (pyro-processing). The main pyro-processing system emissions are nitrogen, carbon dioxide, water, oxygen, nitrogen oxides, sulphur oxides, carbon monoxide, and hydrocarbons. CKD is also produced. The cement kiln itself has been designated as best available control technology (BACT) for the control of SO_2. The highly alkaline conditions of the kiln system enable it to capture up to 95% of the possible SO_2 emissions. However, if sulphide (pyrites) is present in the kiln feed, this absorption rate can decline to as low as 50%. Therefore, sulphur emissions can be decreased through careful selection of raw materials. Options are available to move from coal fuel to oil or gas fuel as they will result in considerably lower sulphur oxides and carbon monoxide emissions.

Possible areas of exploitation for the control of NO_x are as follows:

(1) Stable kiln operation (reduces long-term NO_x emissions);

(2) Staged combustion for pre-calciner kilns;

(3) Recirculation of the flue gas (oxygen deficient air in the rotary kiln);

(4) Alternative/low-nitrogen fuels.

Cement loading and dispatch. In the shipping department particulate matter is emitted from the silos and the handling and loading operations. Active and passive fabric filters can be used to collect this dust. To ensure dust-free loading onto the transport vessel, a flexible loading spout consisting of concentric tubes is used. The outermost tube seals the delivery spout to the transport vehicle. The product is then delivered through the inner tube and displaced air drawn up the outer tube to a filter. At distribution terminals, fabric filters are again used and the collected dust is returned to the product.

Recommendations

Some recommendations are presented as follows:

(1) Rapid flue gas quenching or other measures to minimize post-furnace particulate residence time in the critical temperature zone;

(2) Use of formation inhibitors;

(3) End-of-pipe flue gas cleaning techniques for removal or catalytic decomposition of emissions;

(4) Measuring equipment and instruments such as opacimeters should be upgraded to enhance accuracy of measurements.

Further Opportunities for Improvement (*X* Cement in Zimbabwe)

Carbon monoxide emission (up to 0.1 ppm) is due to incomplete combustion during clinkerisation. There is a need to look at alternative fuel composition and raw materials residence time in the kiln. The levels of SO_x emissions for *X* Cement in Zimbabwe (below 5%) are an indication of a good furnace/kiln design. However there is still a need to completely eliminate SO_x emissions into the natural atmosphere. Catalytic reduction of SO_x emissions at the end of pipe can also be taken advantage of to further reduce such emissions.

Conclusions

The world has become increasingly aware of the need to preserve and conserve resources. Control of pollution is not only a legislative requirement, but has also become a tool for competitiveness. Those companies that choose to implement sound pollution prevention methods are likely to enjoy better business than those that do not, mainly because the former will generally be regarded as socially responsible. Therefore the technological advancement that is being witnessed everyday is an opportunity for industry to minimise waste, and become greener, and more lucrative. There is great potential for cement industries to minimise emissions, particularly those in Africa.

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Logistics Reorganisation in Regional Healthcare Service Experience From Italian Perspective: The Case of Tuscany[*]

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The increasing pressure on public expenditure in Italy and in healthcare sector is creating two important phenomena: first, the progressive regionalization of healthcare systems; and second, the search for new organizational models aiming to public expenditure rationalizing and higher levels of efficiency. The regionalization is changing the administrative and organizational structure of the State in a federal way by identifying distinctive characteristics that are reflected in the organization of the Italian healthcare system. The second phenomenon, however, is leading to different regional administrative models, which tend to compete. In Italy, logistics centralization seems more appropriate to improve the efficiency and to decrease public expenditure of healthcare system. Concerning the reorganization in healthcare service, Tuscany region's goal is to become a benchmark to many other regional systems. This study analyzes the first three years' implementation of logistics reorganization through the evolution of PBP (Percentage of Brokering in Purchasing) ratio and stock variations, in order to measure the performance in the Tuscany healthcare service. This research emphasizes contrasting issues: Tuscany healthcare service shows a significant reduction in the number of warehouses; at the same time the decision to logistics centralization has produced a substantial increase in regional warehouses. We argue that the centralization of logistics in Tuscany healthcare service will produce the desired effect only in the medium-long term, instead we can observe problems of short-term management in logistics centralization.

Keywords: logistics, regional health service, Tuscany, stock variation

One of the key elements of the Italian health service is, undoubtedly, its high level of decentralisation, which since 1990s has led to all regulatory and organisational functions being assigned to the Regions.[1]

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[1] The Region is the principal level of governance between the State and the local autonomies, Provinces and Municipalities.

This process, represented by recent laws aimed at moving the organisation of the State[2] in a more federal direction, has identified the Regions as the central government's primary stakeholders. Through this process attention has been refocused on the results and on the choices made in healthcare, due to the significant role that this sector plays in people's lives, as the first litmus test of the Regions' administrative capacities.

In fact, the Regions have created a wide variety of systems in the healthcare field that have veritable laboratories, where models of governance, organisational structures, and service delivery systems have all been tried out, with varying results.

In particular, the operators focused mostly on the rationalization of administrative support functions, for the purpose of finding adequate economies of scale that would make it possible to free up resources to be applied to assistance, and also to relieve corporate management of administrative responsibility so as to be able to concentrate on aspects of clinical governance.

The ongoing search for more efficient approaches to healthcare quickly focused on procurement and logistics-management functions (Brusoni, Cappellaro, & Marsilio, 2008).

This concentration of such functions on broader scales proved to be an important way of pursuing the sought-after goals; this was done for the creation of agencies with mainly administrative purposes and with a high level of specialisation in the sector (Brusoni & Marsilio, 2007; Brusoni et al., 2008).

The purposes assigned to these institutions sought to achieve:

(1) A reduction in costs through economies of scale deriving from greater purchasing volumes and from greater contracting power with suppliers;

(2) A reduction in transactional costs between agencies and suppliers;

(3) A reduction in personnel, considering individual units due to the functions transferred;

(4) Greater specialisation and qualification of the staff assigned to the same functions in the centralised units;

(5) Standardisation of processes and greater efficiency;

(6) A reduction in warehouse stocks;

(7) A reduction in the number of warehouses and associated operating costs (Johnson, 1999; Schotanus & Telgen, 2007; Tella & Virolainen, 2005).

Because of the variety of healthcare organisational models in Italy, and the differing results that they have produced both economically and in terms of quality of services provided, it has been necessary to focus on two factors:

(1) The specific nature of the solutions adopted and their replicability in regions that differ in socio-economic and epidemiological characteristics—not just in order to arrive at a national model that is valid for all Regions, but also to render effective that virtuous competition among models, which federalism seeks to achieve;

(2) The formulation of a system of ratios that makes it possible to establish, unequivocally, whether or not the solutions adopted are the best solutions; the benchmarking done by many institutions among the regional models often underestimates the difficulty of quantifying the effects of specific choices made by the regional

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[2] An organisational process of State reform is under way in Italy, beginning in the 1990s with a gradual decentralisation of functions toward the Regions, Provinces and Municipalities. The process has not yet arrived at complete transformation of the State in the federal sense, but reform experiments are under way that involve the increased taxation authority of the local autonomies (fiscal federalism) and transfer of the heritage of public assets which are still held centrally (dimensional federalism).

programmes.

In this context, the study offers the following contribution that comes from observing the experience of one Region (Tuscany), which in organising the logistical function in healthcare was undoubtedly a forerunner and a point of reference for many other administrations.

We therefore observed and measured the choices made in this context, which were aimed at pursuing high standards of efficiency and effectiveness, in order to outline an analytical and evaluative methodology that could be applied in other contexts.

The Tuscan Health Service and Creation of the Area Vasta Warehouses

One of the peculiarities of Tuscan healthcare is the geographic distribution on a wider scale (Area Vasta), as compared to the provincial dimensions in which it is normally distributed in other regions.

This distribution, however, does not ignore the existence of the Local Health Units (ASL) at the provincial level, but rather aims at the integration of the scheduling of healthcare services (and their delivery) and the coordination of functions at a broader geographical level.

While not contradicting the model established by legislation, which divided the region into 12 ASLs plus four teaching hospitals (*Aziende Ospedaliero-Universitaria*—AOU, Teaching Hospital), the Tuscan Region identified three Area Vasta (see Figures 1 and 2).[3]

Northwest Area Vasta:
1. Local Health Authority of Massa and Carrara (ASL 1)
2. Local Health Authority of Lucca (ASL 2)
3. Local Health Authority of Versilia (ASL 12)
4. Local Health Authority of Pisa (ASL 5)
5. Local Health Authority of Livorno (ASL 6)
6. Teaching Hospital "S. Chiara" of Pisa (AOU Pisa)

Central Area Vasta:
1. Local Health Authority of Florence (ASL 10)
2. Local Health Authority of Prato (ASL 4)
3. Local Health Authority of Pistoia (ASL 3)
4. Local Health Authority of Empoli (ASL 11)
5. Teaching Hospital "Careggi" of Florence (AOU Careggi)
6. Teaching Hospital "Meyer" of Florence (AOU Meyer)

Southeast Area Vasta:
1. Local Health Authority of Siena (ASL 7)
2. Local Health Authority of Arezzo (ASL 8)
3. Local Health Authority of Grosseto (ASL 9)
4. Teaching Hospital "Le Scotte" of Siena (AOU Siena)

Figure 1. Tuscan Region's Area Vasta.

It is precisely at the Area Vasta level that healthcare planning is carried out, that patient mobility flows, that their limits are regulated, and where the requirements and distribution of particular specialisations are estimated.

Several ASLs operate in each Area Vasta, expressing the requirements and needs of the area, along with at

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[3] In particular, two unique entities that are part of the Tuscan Region's Health System are excluded from the analysis done, because of the unique activity they perform compared to the healthcare units and their lack of relevance for purposes of the analysis. These are the *"Gabriele Monasterio" Foundation* and the *ISPO Foundation.*

least one AO (hospital), which ensures advanced specialisation, integration with the local university system, and the presence of the professional skills essential to the system's improved quality.

Figure 2. Graphic representation of Tuscan Region's Area Vasta.

The Area Vasta represents the outcome of a thorough regional review, which, over time, identified three macro-areas in the Region where it would be possible to implement organisational tools and choices capable of making the Tuscan healthcare system economically "sustainable" by not only maintaining but also actually increasing its ability to provide excellent services while ensuring an improved use by citizens.

The optimal dimension was sought in the Area Vasta to ensure the greatest possible efficiency.

An interesting point in this study is the establishment, within the Area Vasta, of service units (called Area Vasta Technical Administrative Support Agencies—ESTAV), which are to take on certain administrative and support functions previously performed by the ASL. According to the classification proposed by Aylesworth (2003), these agencies were "regional purchasing agencies", assigned to perform varied functions within the collaborative purchasing phenomenon.

The ESTAV's goals (Del Vecchio & Rossi, 2004) are, on the one hand, the achievement of significant economies of scale in production and the standardisation, together with the delivery of administrative services to the units; on the other hand, the possibility for the ASL to concentrate its own efforts on more typically health-related functions.

Therefore, regional legislation assigns the following functions to the ESTAVs:

(1) Procurement of goods and services;

(2) Management of warehouses and logistics;

(3) Management of informational networks and of computer technologies, with special attention on integration and organisation of the Unified Appointments Central (CUP);

(4) Asset management for maintenance, contracting and sales functions;

(5) Organisation and management of personnel training;

(6) Personnel recruitment management;

(7) Payroll management.

The first function transferred by the ASLs to the ESTAVs was purchasing. The idea was to create a single contractor for all the ASLs in the Area Vasta, capable of setting up complex tenders for more significant purchase quantities compared to those of the individual ASL, as well as to standardising the consumption behaviours of healthcare operators.

The second function transferred was logistics. In this case, the goal assigned to the three ESTAVs was to create single Area Vasta warehouses, where purchased drugs, healthcare products, and devices were to be delivered, stored and, subsequently, delivered to the departments of the various units. This organisational solution, integrated with the purchasing function, was implemented as a means of achieving a constant flow of goods and a substantial reduction of stock, thereby reducing the costs associated with the deliveries and the warehousing of goods.

This aspect is especially interesting in the ESTAV model as compared with those proposed in other regions. It consists of the integration between the purchasing function and the logistical function, which by entrusting warehouse management to the clients achieves transfer and internalisation of the transport and delivery system with the dual result of promoting savings in awarding contracts and customising the just-in-time system directly to the patient.

In summary, we can state that the purchasing and logistical functions constitute the bases on which the ESTAVs have developed the first and most significant experiments of this kind at the national level.[4]

Operating Models and Quality Standards

Despite of the identical legislative set-up and a similar system of goals defined by the regional system, the three ESTAVs have followed diametrically different paths to centralise warehouses and the logistical function, and they have created three different operating models.

Behind this choice there were the geographic differences that imposed different options for locating the warehouses and delivery mechanisms. In reality, however, the novelty of the paths taken led to different approaches involving a significant problem in terms of assessment. Hence, we are looking at a threefold organisational and logistical solution relating to the centralisation of the functions themselves, which undoubtedly made it more important to consider the comparability of the results obtained by the various models implemented.

First, let us look at the three different solutions identified by the ESTAVs in Tuscany.

Central ESTAV

The Central Area Vasta made the first move to combine its warehouses; it is located in the Florence metropolitan area where there are four ASLs (of which Florence ASL No. 10 is one of the largest in Italy) and two teaching hospitals. In this area it was decided to create a large warehouse (called *Magazzino di Area Vasta*—Area Vasta Warehouse), centrally located in the various urban areas, and close to the motorways. The

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[4] Experiments similar to the creation of subjects assigned to perform a centralised function for the Region or for territories of reference for health programming in Italy were conducted in Umbria, Piemonte, Emilia Romagna, and Veneto.

various suppliers are thus called upon to deliver all the products (drugs and healthcare products) requested by the healthcare facilities directly to the central warehouse.

This solution is intended to achieve a more favourable pricing policy, because the regional health service takes over the delivery system, and to obtain a significant reduction in inventory storage and maintenance costs, which are optimised by the new warehouse.

The unique aspects of the model are not to be found in the operation of the centralised warehouse, but rather in the idea of providing direct delivery by the warehouse itself to the units and the individual facilities operating within the territory. Using a computerised request and delivery system, the new warehouse should promote a quick response to requests from the healthcare facilities and professionals, and a more careful and precise scheduling of purchasing through the use of statistical data regarding requests and deliveries.

This operating hypothesis is supported by a transition in stages, which having started with the transfer of logistics from the Florence ASL No. 10 continues with the others.

At the present time, as we shall see in the analysis provided in the following paragraphs, the transfer process cannot yet be said to have been fully concluded.

Northwest ESTAV

The way logistics that were centralised in the Northwest Area Vasta was different from the solution just described. The creation of a single warehouse for the entire Area Vasta remained a part of the solution, but this was achieved by starting simultaneously with all the units rather than in successive steps as in the previous case. This decision was made in order to reduce the time spent on reorganisation, personnel training, and the designing of computer solutions by testing a single model for all units right from the start. The simultaneous start-up of the process initially involved drugs which, while not the most conspicuous type of goods consumed at the healthcare units, do encompass all of the most significant complexities.

As well as in this case, however, the unique aspect was found more in the distribution model than in the ways in which the warehouse inventories were centralised. In this case it was decided to make deliveries to specific logistics platforms set up at the units. The personnel working at these platforms subsequently took charge of delivering to the departments.

Initially, these platforms were set up at the warehouses of the units in the Area Vasta that already had the operating structures and professional skills necessary for experimentation. Among other things, these warehouses could not be closed immediately as they were required to manage healthcare products and devices that had not yet been centralised in the purchasing and logistics functions. So, if on the one hand this mechanism did not create staffing and delivery duplications between drugs and devices and limited organisational change for the units, on the other hand it did not produce any positive effects in reducing the number of warehouses active in the Area Vasta, even though there was a reduction in drug stock at the healthcare units.

Southeast ESTAV

The choice made by the third Area Vasta is different. In this case, the intention was to gradually take over online management of stocks, of factors of production, and of personnel in the existing unit warehouses, albeit as part of a streamlining in terms of quantities and sizes. The complexity of the Southeast Area Vasta (Tuscany's largest and equipped with the least-developed road system) made it opportune to maintain logistical centres at the units and to use the same online system to manage stocks of resources and their handling.

Transfer of the purchasing and logistical functions began in the Siena area (and in particular with the hospital unit's warehouse), ending with the recent takeover of the management of all the warehouses.

The differences in the models adopted, and the necessary running-in of the delivery system and relative document flows (order/packing list/invoice), at first created quite a few operating difficulties for the system.

Although the logistical mechanism held up well, there were significant problems in synchronising the processes, and it was difficult to reorganise management control.

The Region's choice, in order to make operation of the healthcare facilities uniform and to facilitate administrative procedures while adapting to the unique features of the region and the organisational autonomy that each ESTAV has had up until then, was to set standards for results (i.e., service standards) by which one could measure the various levels of relationship between ESTAVs and healthcare units in the Area Vasta.

These standards, identified for their main functions, are summarised in a special decision by the Region's council and include self-audit mechanisms. As we shall see from the indicators, the service standards are helpful in developing the logistical function which is today beginning to show some interesting results.

Research Method

The purpose of this work is to analyse the purchasing and logistical functions adopted in the various ESTAVs in Tuscany after they are introduced. The process now under way, and in some respects well established in the Region's various Area Vasta, allows us to offer an overall analysis of the results achieved by the regional healthcare system.

The various solutions adopted in the ESTAVs would also require a comparison of the models of the centralisation of the purchasing and logistical functions adopted in the various areas and in several sectors of the public administration (Bovaird, 2006; Kamann et al., 2004), as a future prospect for the development of this work.

The method applied in this study is inductive; it is carried out in part by collecting quantitative and accounting data, along with interviews at the ESTAVs.

In particular, the general purpose of the research can be attained through an analysis at two levels:

(1) Primarily qualitative and relating to the definition, description, and assessment of the three different models of centralisation of the logistical function in the Area Vasta;

(2) Primarily quantitative, which explores some significant indicators suitable for measuring the results achieved and the prospects for development.

The work was conducted through interviews and direct contacts with the ESTAVs, for the purpose of comparing the management solutions identified by each and the implementation of the service standards established by the regulatory authority, the Tuscan Region.

Meeting the proposed standards is in fact considered as a measure not only of full activation of the function, but also of its having achieved full performance.

In particular, the following standards were considered as factors constituting complete transfer of the logistical function:

(1) The creation of uniform price lists for the procurement of healthcare materials: This objective was functional in obtaining uniform prices throughout the region, and in ensuring proper input into management accounting, for which uniformly priced consumption promoted comparability;

(2) Computer storage and digitisation of exchanges between the Area Vasta's ESTAV and healthcare units:

This standard had modernisation as its objective, through the elimination of hardcopy documentation on the one hand, and the start of an automated delivery-matching process on the other hand;

(3) Quality control of deliveries and proper management of the invoicing function: This standard would obviously seem to be a prerequisite for a proper system of supplier-customer relations which, even with the financial and fiscal cross-purposes of the roles and functions performed, remain part of a single system;

(4) Monitoring of compliance with the system of standards: This control was viewed not just as a way of checking on the implementation of the model, but also as the right method to achieve accountability for the work done.

The topics dealt with through the interview methodology are as follows:

(1) Single price list for drugs, with periodic updating;

(2) Computerised file of drug sales to units and shipping documents for pharmaceutical products;

(3) Quality control (consistency between orders and deliveries);

(4) Monthly invoicing;

(5) Quality control over compliance with standards and reporting to units.

The second survey, conducted through extrapolation of quantitative data from accounting documents and unit reports, led to the construction and use of specific performance ratios.

In particular, the ratios considered appropriate to use[5] for the purpose of the analysis were:

(1) PBP (Percentage of Brokering in Purchasing) achieved;

(2) Inventory analysis;

(3) The active-warehouse situation from December 31, 2007 to the same date in 2009.

The first one is a technical-accounting indicator determined as the ratio between the revenue of each of the three ESTAVs and the products consumed inside the Area Vasta. With a higher percentage of brokering there is a more significant role played by the ESTAVs as business broker, and therefore a more complete integration between the purchasing and logistical functions.

The second—an analysis of the inventory dynamic in the Area Vasta—seeks to understand the actual savings in terms of stocks present in the warehouses and the ease of delivery flows.

Finally, the third aspect of the analysis, focusing on a count of the number of unit warehouses, monitors the actual cost savings due to centralisation of the function by rationalising the resources used.

Centralization of the "Logistics" Function

The survey shows clearly that the situation with transferring logistical function is different in the three ESTAVs as a consequence of the different organisational and management choices made. In all cases, however, the expected result seems to have been reached, and the standard set by the Region has been assured.

As Table 1 shows, all the ESTAVs involved adopt a single price list for pharmaceutical materials, which is periodically updated. In particular, we see differences in the frequency of price list updates, which is either annual or quarterly.

All three ESTAVs have a computerised file of drug sales to units in the Area Vasta and for shipping documents for pharmaceutical products. The storage and digitalisation of the documentation make it possible to achieve improvements in terms of cost reductions (associated with management of hardcopy materials) and

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[5] It is no accident that some of these indicators were adopted into the regional assessment model used to evaluate the performances of these entities within the Bersaglio project (AA.VV., 2009). Retrieved from http://www.meslab.sssup.it.

greater efficiency.

Quality control was analysed with reference to consistency between orders for pharmaceuticals, sent by the units to the ESTAVs, and deliveries of materials. In this area we can see the prospects for improvement that would lead to monthly updating/data checking, compared to the quarterly updates done up to now. In addition, quality control calls for monthly billing for the goods delivered, an objective that now seems to have been reached region-wide.

Table 1

Results of ESTAV Service Standard Monitored

Standard monitored	Comment	Status
Single price list for drugs, with periodic updating	At least every month, and at least 15 days before the valid date, ESTAV sends a report in the same format as the price list, relating to the new products managed, including replacing or supporting other products. ESTAV guarantees that the prices applied and those shown on the list will match.	OK
Computerised file of drug sales to units and shipping documents for pharmaceutical products	ESTAV undertakes to keep a computerised archive of orders received that can be consulted by the units in the manner agreed to. ESTAV notifies the party indicated by the unit of any change, substitution or addition to the orders received. Substitutions made outside of the agreed procedures may be subject to prior authorisation or subsequent explicit approval. ESTAV undertakes to keep a computerised and hardcopy archive of deliveries made (shipping documents) and to send the delivery flow to the units in real time.	OK
Quality control (consistency between orders and deliveries)	ESTAV ensures monitoring of the consistency between orders and deliveries. This end ESTAV undertakes quarterly to send to the units a report containing any discrepancies between orders and deliveries (orders partially filled, products different from those requested, etc.).	Undergoing improvement: The goal is monthly communication
Monthly invoicing	ESTAV sends monthly invoices for sales made in the previous month.	OK
Quality control over compliance with standards and reporting to units	ESTAV undertakes to implement a mechanism for measuring compliance with standards, setting up periodic reporting to the units.	OK

The area of monitoring compliance with standards is implemented differently among the three ESTAVs due to the varying management decisions that are made.

More specifically, with regard to the Central ESTAV, 2009 was a year of consolidation for the facility which manages the "historic" function of procurement. It is doubling the volume of activity at the centralised warehouse for the logistical function and moving toward the completion of this process, implementing the competitive bidding function, management included, running the payroll function, albeit with non-uniform software, and coordinating and maintaining healthcare technologies and computer technologies.

In 2009, ESTAV became responsible for all institutional functions established by Article 101 of Regional Law No. 40/2005, with the exception of the organisation and management of ongoing personnel training, asset management for functions that can be optimised in terms of maintenance, and contract and asset disposal, all of which at the moment have not yet been transferred.

In 2008, for the Central ESTAV, transfer involved its taking charge of the logistical function for all categories of goods, so as to serve only the units in the Area Vasta. As of December 31, 2008, there was a complete transfer of goods categories (drugs and medical devices) in three units (ASL 3, ASL 10, AOU Meyer) and a partial transfer, limited to the drugs category, for ASL 4 and ASL 11.

During 2009, the Central Area Vasta Warehouse (MAV) supplied completely only a few healthcare

entities, and this was the case of the AOU Careggi and Prato ASL 4.

Finally, in 2010, the Prato ASL 4 passed on all logistics, whereas for Careggi there remained some specialist medical devices already managed in transit by the hospital unit itself.

With reference to the Southeast ESTAV, as of December 31, 2008, the function had been transferred only for the Siena AOU, but remained entirely to be transferred for the three healthcare units (ASL 7, ASL 8 and ASL 9).

As of June 14 and November 3, 2009, the Southeast ESTAV had taken on the warehouse and logistics-management function, including the receipt, storage, and preparation of goods (drugs, medical and surgical products, miscellaneous office supplies, etc.), as well as the transport and delivery of these goods to the hospitals, and areas of interest of the Arezzo ASL 8 and the Siena ASL 7, respectively.

In 2009, the consolidation of the goods-and-services procurement function and transfer of the logistical function from the Area Vasta units was made, more specifically, three out of four, were transferred to the ESTAV. It is worth noting that for the Grossetto ASL 9 the transfer occurred in early January 2010.

All in all, 2009 saw the consolidation of the activities run by the Southeast ESTAV, with a long-term eye on synergy with the efforts of the Area Vasta's healthcare units, as outlined by the Tuscan Region authority.

The model adopted by West ESTAV opted for the transfer of the goods categories one by one, with full involvement of all of the Area Vasta's units.

As of December 31, 2008, drugs had been completely transferred with reference to the complete cycle of order-purchase-storage-delivery, with the exception of a few types. In the beginning of November and December 2009, the transfer of medical products was begun, with the intentions of gradually bringing the complete transfer to a conclusion.

In short, we can state that at the time of our investigation, transfer of the logistical function had been for the most part completed. Today, centralisation of the warehouses and of the logistical function is an established fact in the Tuscan Region. The effects on the system can therefore be measured, and these organisational choices can be applied in other Italian regions.

The PBP Ratio

Calculating the percentage of brokering in purchasing makes it possible to assess what share of the goods purchased by the healthcare units in the Area Vasta was invoiced by the ESTAVs. In other words, this indicator gives us an idea of the magnitude of the assets used in the Area Vasta that are effectively managed and "transited" through the ESTAV warehouses. An increase in the percentage will show the growing role of the ESTAVs in the centralisation of the purchasing and logistical functions.

For each unit, we assessed the volume of products transferred to the units from the warehouses run by the ESTAV, comparing it with the total volume of products consumed in the Area Vasta. Ultimately, the indicator is assumed in the following forms (Vainieri & Calabrese, 2009, p. 383; Vainieri et al., 2009, p. 159): ESTAV sales to the Area Vasta units/total purchases in the Area Vasta.

We assume that the transfer of centralised purchasing has been fully implemented if the value of consumed goods (passed through the ESTAV warehouses) is higher.

The survey's results, summarised in Table 2, showed that the expansion of the function has been very different in the three Area Vastas. It should be kept in mind that, in terms of the nature and type of goods, not all products consumed are subject to passing through the ESTAV warehouse.

Sales by the Central ESTAV were determined using the balance sheets for the years closing December 31, 2008 and 2009, considering the item "sale of goods" containing proceeds from sales of healthcare and non-healthcare related goods to the Area Vasta units and to other facilities in the Tuscan health service (e.g., ESTAVs in other areas). In particular, in determining the numerator, intra-ESTAV sales and relationships were excluded, as they would have "polluted" the sought-after information regarding the share of goods purchased only by the healthcare units in the Area Vasta and billed by ESTAV. Instead, the value of the goods consumed was obtained by processing the balance sheets of the healthcare units.

Table 2

Percentage of Brokering in Purchasing

	ESTAV sales 2008	ESTAV sales 2009	Area Vastas consumption 2008	Area Vastas consumption 2009	Brokering percentage 2008	Brokering percentage 2009
Northwest ESTAV	€167,634,190.00	€193,495,741.00	€396,569,000.00	€426,791,000.00	42.27	44.76
Central ESTAV	€106,498,079.00	€203,101,764.00	€472,015,000.00	€519,953,000.00	22.56	39.06
Southeast ESTAV	€58,632,111.31	€96,334,339.30	€234,351,000.00	€247,746,000.00	25.02	38.88

The sale of goods was assessed at the list price set by ESTAV for the current year. In 2009 expansion of the centralised warehouse activity caused a significant increase in the purchase volumes in terms of value, quantity, and variety of products. The increase in purchases of goods brokered by Central ESTAV is reflected in the brokering percentage, which went from 22.56% in 2008 to 39.06% in 2009.

During 2009, ASL 3 Pistoia, ASL 10 Florence, AUO Meyer, and ASL 11 Empoli were served, whereas for ASL 4 Prato and AOU Careggi, service had begun but was not yet up to full speed.

As it will be shown below, the increase in activity had an impact on inventory, both in terms of volume and products managed; in order to avoid making warehouse management more burdensome, necessary measures were taken to ensure continuity of supply by keeping stocks within the safe limit.

At Southeast ESTAV, in 2008 the percentage of brokering was 25.02%, further increasing during the following year to 38.88%, a figure slightly lower than that reached in other areas.

For Northwest ESTAV, the brokering percentage rose from 42.27% in 2008 to 44.76% in 2009, reaching the highest value in the Region.

Considering the entire Tuscan Region, the ESTAV brokering percentage went from 30.17% in 2008 to 41.06% in 2009, indicating that, in that year, almost half of the products used in the process of delivery healthcare services were managed by ESTAV, in line with the centralised logistics model.

Stock Variation

In conducting their activities, and in order to achieve the sought-after advantages through the centralisation of functions, the objectives that the ESTAVs must pursue include rationalising Area Vasta inventories (to reduce stocks and improve liquidity) and reducing the number of warehouses. In this context, we surveyed the physical make-up of the inventories at each ESTAV, comparing the data with the total stocks in the Area Vasta. The comparison was then extended to the stocks of healthcare and non-healthcare goods present only at the units in the Area Vasta.

Gradual centralisation of the warehouse management function should lead to an increase in ESTAV

inventories, with a corresponding decrease in stocks at the units in the Area Vasta. In order to evaluate the approach taken, the warehouse inventories were analysed over the three year period from 2007 to 2009, based on the latest available data, relating to the balance sheet for the year ending on December 31, 2009.

Through the analysis of the data for the three ESTAVs, we have found an increase in warehouse stocks, in terms of both absolute value and percentages (see Table 3 and Figure 3). The growth was more homogeneous over time at the Northwest ESTAV than at the Central and Southeast ESTAVs, which experienced major increases due to their unique warehouse management decisions, which we dealt with above.

Table 3

ESTAV Inventory Trends, 2007-2009

Inventory	2007	2008	% variation 08-07	2009	% variation 09-08
Northwest ESTAV	€11,780,050	€13,024,771	10.57	€13.816.738	6.08
Central ESTAV	€5,154,958	€15,409,061	198.92	€20.155.757	30.80
Southeast ESTAV	€3,165,028	€3,259,848	3.00	€9.631.170	195.45
Total	€20,100,036	€31,693,680	57.68	€43,603,665	37.58
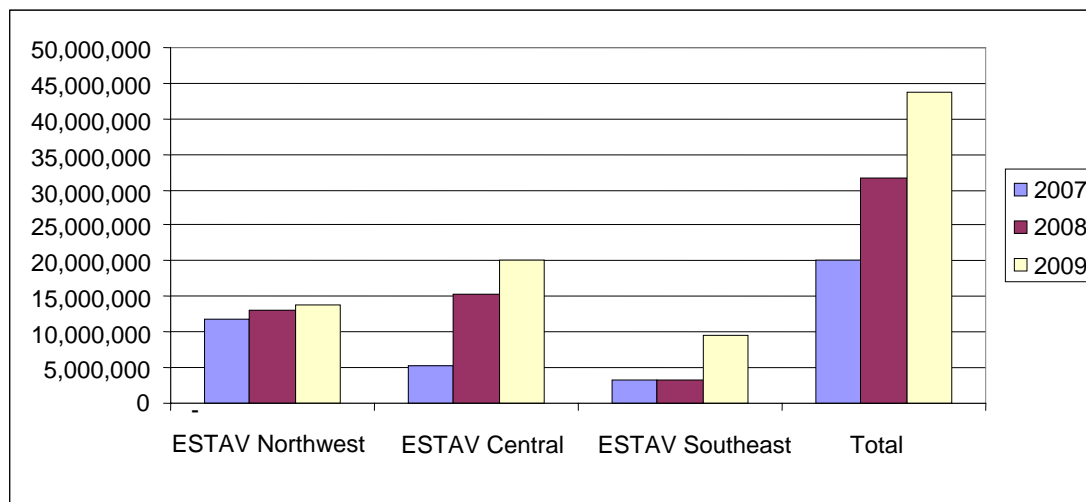
Figure 3. ESTAV inventory trends, 2007-2009.

Extending the comparison to inventories in the Area Vasta, including the stocks of the individual healthcare units, the results of the analysis become those appearing in Table 4. It is noted that the warehouse inventories are raised over the three-year period, with a single negative balance in the comparison between 2008 and 2007 for Northwest ESTAV. Hence, it seems obvious that while centralisation of warehouse management may have promoted operating cost containment, it has not prevented a steady growth of inventory stocks at the units.

For the purposes of our survey, it is important to consider the weight—in terms of percentage value—of the ESTAV warehouse inventories with respect to the total stocks in the Area Vasta. This is an indicator capable of highlighting the growing role played by the ESTAVs in the centralisation purchasing and logistical functions.

The percentage indicator is constructed by comparing the total ESTAV inventories with the total Area Vasta inventories. The survey results are shown in Table 5 and Figure 4.

Table 4

Area Vasta Inventory Trends, 2007-2009

Inventory	2007	2008	% variation 08-07	2009	% variation 09-08
Northwest Area Vasta	€69,720,565	€64,920,336	-6.88	€69,046,750	6.36
Central Area Vasta	€64,656,978	€77,075,166	19.21	€95,318,360	23.67
Southeast Area Vasta	€31,808,035	€33,738,031	6.07	€37,113,280	10.00
Total	€166,185,578	€175,733,533	5.75	€201,478,391	14.65

Table 5

Percentage Weight of ESTAV Inventories Compared to Area Vasta

	2007	2008	2009
Northwest ESTAV	16.90	20.06	20.01
Central ESTAV	7.97	19.99	21.15
Southeast ESTAV	9.95	9.66	25.95
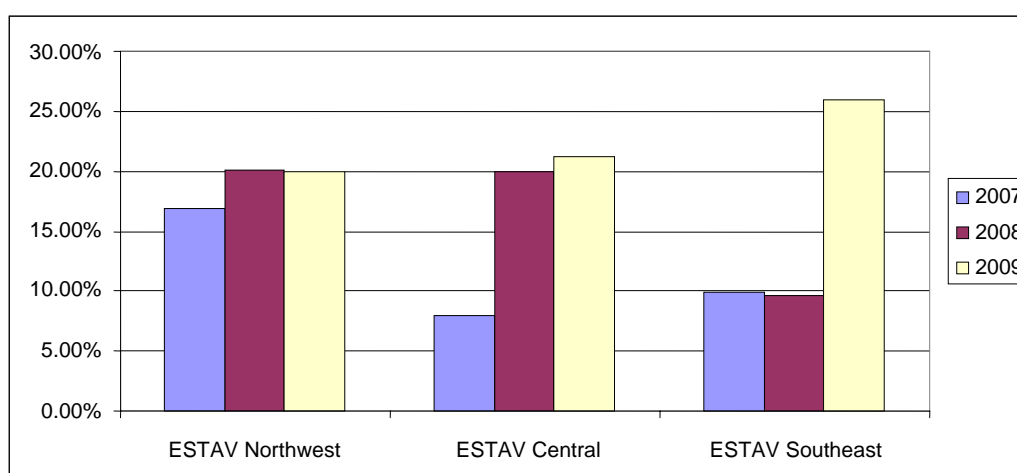
Figure 4. Percentage weight of ESTAV inventories.

In general, the weight of the goods in inventory, transiting through the ESTAV warehouses, seems to be growing, especially with reference to 2007 and 2009. This is true for all with the exception of Southeast ESTAV, which undergoes a decided increase in 2009, reaching higher values than the other two areas. The percentage weights—which vary between 20% and 26%—may suggest the existence of goods in inventory managed directly by the healthcare units' warehouses or, rather, kept in the departments as supply for the rendering of services.

The maintenance of this supply, or rather the significant growth in it, especially at the hospital units, should cause us to consider the time required to centralise a support function of this significance.

We must ask ourselves, in fact, what are the standards of efficiency—and also of security—for maintaining such a high volume of supply in the "department cupboards" in the face of a centralised function.

Now let us move on to analyse in greater detail the trend in inventories in the individual Area Vasta.

The increase in the total inventory value for Central ESTAV, recorded in 2009 at approximately 4.7M Euro, derives from the need to adapt inventories to the gradual increase in logistics activity and delivery of healthcare goods to the units, in order to gradually bring the logistical function up to full operating speed. The

increase recorded is wholly attributable to inventories of healthcare materials (4.8 million Euro), against a slight reduction in non-healthcare materials. The reduction in non-healthcare materials comes in the wake of the changes made to the supply service within the Area Vasta. In fact, because of the unfitness of the buildings where the non-healthcare goods were located, in 2009 ASL 10 again took over their management. As a result, in the second half of the year the ESTAVs' office supplies business was limited to supplies for the Meyer Unit. Finally, we should note that the scheduling of warehouse inventories in the entire Area Vasta has led to the establishment of a volume capable of maintaining the average rotation index of close to 30 days.

By analysing inventories at the unit warehouses in the Central Area Vasta, we find a growth trend, especially when comparing 2009/2008, apparently going against the trend toward centralisation of the logistical function. The increase—albeit with different values—affects all the units in the Area Vasta and shows a total Area value of 21.89% (see Table 6).

As of December 31, 2009, Southeast ESTAV inventories consisted of the value of the stocks of healthcare materials not present in the warehouses of Siena AOU, ASL 8 and ASL 7 (see Table 7). The major increase in the final value of the inventories compared with 2008 was caused by transfer of the logistical function to ESTAV for ASL 8 and ASL 7, which occurred on July 14 and November 3, 2009. This shows the gradual implementation of the centralisation of the logistical function done within the Vast Area.

Table 6

Inventory Variations in the Central Area Vasta Units

Central Area Vasta inventories	2007	2008	% variation 08-07	2009	% variation 09-08
ASL 10 Florence	€16,665,554	€12,575,566	-24.54	€14,435,366	14.79
ASL 4 Prato	€6,766,087	€7,122,850	5.27	€8,346,628	17.18
ASL 3 Pistoia	€11,848,285	€10,651,940	-10.10	€12,596,153	18.25
ASL 11 Empoli	€5,005,898	€5,035,399	0.59	€5,975,468	18.67
AOU Careggi Florence	€17,568,486	€22,430,982	27.68	€29,557,452	31.77
AOU Meyer	€1,647,710	€3,849,368	133.62	€4,251,537	10.45
Total	€59,502,020	€61,666,105	3.64	€75,162,603	21.89

Table 7

Inventory Variation at Southeast ESTAV

Balance on December 31, 2009	Balance on December 31, 2008	Variation
€9,631,169.56	€3,259,848.00	€6,371,321.56

Considering the units' inventories (see Table 8), we find an overall negative trend for 2009/2008 equal to -9.83%. The AOU Siena seems to be bucking the trend. However, its inventories increased in line with what happened at the other University Hospital Units in the Region (AOU Careggi, Meyer and Pisana). The decrease in inventories in the units' warehouses, while restrained in general terms, seemed consistent with the gradual centralisation of the logistical function in Southeast ESTAV.

As of December 31, 2008, for Northwest ESTAV, inventories consisted of the value of stocks of healthcare materials stored in the single drugs warehouse, which handled some 194 million Euro in goods. In 2009, logistical activity involved the management of some of the healthcare goods whose warehouse stocks at the end of the year amounted to €13,816,735, with an increase over the previous year of approximately €602,000. This increase is explained by the greater sales and by the management of medical-surgical devices (see Table 9).

Table 8

Inventory Variations in the Southeast Area Vasta Units

Southeast Area Vasta inventories	2007	2008	% variation 08-07	2009	% variation 09-08
ASL 7 Siena	€4,197,014	€4,496,390	7.13	€3,558,692	-20.85
ASL 8 Arezzo	€12,051,673	€13,249,239	9.94	€10,172,659	-23.22
ASL 9 Grosseto	€7,933,916	€8,967,773	13.03	€8,378,450	-6.57
AOU Siena	€4,460,404	€3,764,781	-15.60	€5,372,309	42.70
Total	€28,643,007	€30,478,183	6.41	€27,482,110	-9.83

Table 9

Inventory Variation at Northwest ESTAV

Balance on December 31, 2009	Balance on December 31, 2008	Variation
€13,816,735.00	€13,214,771.00	€601,967.00

Considering inventories in the units in the Area Vasta (see Table 10), the 2009/2008 comparison shows an overall growth of 6.43%, differing from unit to unit. The increase goes against the trend with respect to the comparison between 2008 and 2007, when a decrease of 10.43% is recorded.

Table 10

Inventory Variations in the Northwest Area Vasta Units

Northwest Area Vasta inventories	2007	2008	% variation 08-07	2009	% variation 09-08
ASL 1 Massa Carrara	€11,433,184	€8,466,298	-25.95	€8,959,194	5.82
ASL 2 Lucca	€5,589,218	€5,805,857	3.88	€6,826,763	17.58
ASL 12 Versilia	€5,273,578	€5,127,859	-2.76	€5,169,804	0.82
ASL 5 Pisa	€6,577,042	€6,361,762	-3.27	€5,202,466	-18.22
ASL 6 Livorno	€9,486,678	€8,927,802	-5.89	€9,794,770	9.71
AOU Pisa	€19,580,815	€17,205,987	-12.13	€19,277,015	12.04
Total	€57,940,515	€51,895,565	-10.43	€55,230,012	6.43

Reduction in Numbers of Warehouses

The analysis conducted also involved the number of warehouses active in the Central Area Vasta, with a comparison referring to the end of the years of 2007, 2008, 2009.

Centralisation of the logistical function should in fact have led to a gradual closing out of the unit warehouses, replacing them with the central warehouses run directly by ESTAV.

Once implemented, this approach was to have led to significant savings in terms of operating costs for the facilities and higher levels of efficiency, due among other things to the specialisation of staff.

The result expected in this analysis, therefore, is a gradual reduction over the three-year period in the number of warehouses active at the units in the Area Vasta.

The situation found at the Central ESTAV is shown in Table 11.

At the end of 2007, the Central ESTAV warehouses coexisted with many other facilities, reducing the desired positive effects in terms of costs and stock rationalisation. The expected reduction was gradually achieved over the three-year period. As of December 31, 2010, all pharmaceutical materials, products, and devices were stored at the Central ESTAV; only those office supply warehouses used for non-healthcare goods at the healthcare units remained in operation, where inventories, in terms of value and quantities of goods, were

in any case well below those of the healthcare goods.

Because of its decision to integrate pre-existing warehouses, the Southeast Area Vasta (see Table 12) has maintained the previous facilities, assigning them to ESTAV and not establishing a single, centralised warehouse.

As we have seen, the logic of inventory scheduling, which has not achieved the expected reduction in warehouses, has ensured a greater reduction in the stocks stored in them with respect to the enormous logistical difficulties of the area.

Finally, we note that in regard to the Northwest ESTAV warehouses, data are collected on the platforms as a new unit of organisational reference (see Table 13).

Table 11

Trend in Numbers of Warehouses in the Central Area Vasta

Unit	Number of warehouses 2007	Number of warehouses 2008	Number of warehouses 2009
ASL 10	3	5	1
AOU Careggi	3	2	2
ASL 3	16	2	1
ASL 4	2	2	2
ASL 11	6	2	2
AOU Meyer	0	0	0
ESTAV	1	1	1
Total	31	14	9

Table 12

Trend in Numbers of Warehouses in the Southeast Area Vasta

Unit	Number of warehouses 2007	Number of warehouses 2008	Number of warehouses 2009
ASL 7	4	3	0
ASL 8	3	3	0
ASL 9	3	3	0
AOU Siena	0	0	0
ESTAV	2	2	11
Total	12	11	11

Table 13

Trend in Numbers of Warehouses in the Northwest Area Vasta

Unit	Number of warehouses 2007	Number of warehouses 2008	Number of warehouses 2009
ASL 1	9	7	5
ASL 2	5	5	6
ASL 5	3	3	3
ASL 6	5	5	6
ASL 12	2	2	2
AOU Pisa	5	5	3
ESTAV	1	1	1
Total	30	28	26

From the data presented we see that at the regional level the number of warehouses has decreased significantly over the three-year period (see Table 14).

We should keep in mind in particular the public nature of the institutions considered, and the constraints on the mobility of personnel from the healthcare units to the relative ESTAV. Despite of this, the success of the centralisation initiative is obvious both in the Central Area Vasta and in that of the Southeast.

The reduction effect obtained by the Northwest Area Vasta was not as strong. However, it should be considered that the traditional warehouses were replaced by delivery platforms which, while technically still classified as warehouses, in fact appear as lighter and less costly structures.

Table 14

Trend in Numbers of Warehouses in the Tuscan Region

	2007	2008	2009	Difference over the three-year period
Northwest Area Vasta	30	28	24	-6
Central Area Vasta	31	14	9	-22
Southeast Area Vasta	12	11	11	-1
Total	73	53	44	-29

Conclusions

The results of the analysis conducted on the logistical activity of the three ESTAVs can be summarised in Table 15, considering the data as of December 31, 2009.

Table 15

Summary of Analysis on December 31, 2009

	Brokering percentage 2008	Inventory at ESTAV warehouse	Area Vasta inventories	Area Vasta inventories/ unit inventories	No. of warehouses
Northwest ESTAV	44%	+ 6%	+ 6.36%	20.01%	24
Central ESTAV	39%	+ 30%	+ 23.67%	21.15%	9
Southeast ESTAV	38%	+ 195%	+ 10.00%	25.95%	11

A cross reading of the qualitative analysis and the quantitative analysis yields an obvious summary. Centralisation of the logistical function and warehouses is now an established fact in the Tuscan Region.

This fact may be underestimated by the "brokering percentage" indicator, which refers to an annual average in which the transfer has produced its effects only in recent months.

We should appreciate the significant reduction in the number of warehouses, which has already, in the short term, had an impact on the units' organisation and costs.

The decision to centralise and the operational difficulties to which we have referred have instead produced an economic effect which can be easily measured by the inventory indicators.

Far from reducing stock volumes, the creation of single warehouses has generated a substantial increase in both the ESTAV warehouses and the Area Vasta warehouses.

This happens not just in relation to what goods are at present in the centralised warehouses, in which the rationalisation effect is evident, but also at the units, where (if we exclude the local warehouses of the Southeast Area Vasta) there have been major increases in stock. This increase is distributed among the warehouses still remaining at the units but also significantly in the stocks maintained in the departments.

Obviously this factor was especially significant for the hospital units (see Table 16).

We obtained the greatest result from the stocks in the Area Vasta and in the individual units. Indeed, in the

hospitals (whose logistics have been entirely transferred to the ESTAVs), inventories are 33% larger than the stocks at the centralised warehouses (with high percentages of growth compared with the past).

Table 16

Analysis of Hospital Unit Inventories

Tuscan Region hospital unit	Inventory on December 31, 2009	Variation 08/09
AOU Careggi	€29,557,452	+ 31%
AUO Pisa	€19,227,015	+ 12%
AOU Siena	€5,372,309	+ 42%
AOU Meyer	€4,251,537	+ 10%
Total	€58,408,313	+ 24

In our judgment, this is the result of two specific factors:

(1) On the one hand, an elongation of the delivery process, which has inevitably increased time, and consequently, the minimum warehouse stock. This phenomenon is obviously more pronounced at the specialised facilities, the University Hospital Units, where the drugs used are more costly;

(2) On the other hand, the psychological effect of delays and running out of stock has made operators (who work in a sector where interruption of activity has immediate effects on personal health) feel a mostly irrational need to hoard.

We are therefore convinced that time will reduce the need for these warehouse inventories. But the problem of short-term management and the effects that this situation produces remain.

It is apparent from reading the balance sheets from the three ESTAVs that this abnormal inventory growth has created a delicate problem of liquidity (invested in increasing stocks).

This in fact is yet another problem that is emerged from the interviews with the operators with whom our indicators were compared.

And this is probably one of the most significant problems that the innovation process has discounted throughout Italy's public administration. The scarcity of financial resources often prohibits the introduction of models and systems that produce the desired effects only in the medium-long term.

We should ask ourselves then, whether the Area Vasta approach and the relative centralisation of logistics, being exported to three real-life situations, should not provide for more individualised implementation times and, in light of what happened in Tuscany, more training to support the cultural adjustment that the "just-in-time" approach involves. In general, centralisation of the purchasing and logistics functions requires the presence of communication channels between the institutions involved (Enthoven, 1994), and a clear definition of the objectives and purposes sought to achieve at the regional level.

The high level of hospital specialisation warrants a separate consideration. With the progressive specialisation of facilities and implementation of care-intensity models, synchronisation with the new visions of logistics is essential.

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An Empirical Discourse Analysis on Correlations Between the Minimum Wage and Domestic Private Investment

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This research has an objective to empirically analyze the discourse about correlations between the minimum wage and domestic private investment, which has been criticized severely by the authorities, especially since the Pua Thai Party's policy announcement on the guarantee of labors' minimum wage at 300 baht per day. The research uses an advanced quantitative methodology, analyzing time-series data of the minimum wage, import of capital goods and domestic machinery sales by regression and the Johansen Cointegration Test. The regression analysis reveals that the minimum wage correlates in the same direction with both imports of capital goods and domestic machinery sales, whereas when applying the Johansen Cointegration Test, the findings surprisingly indicate that they do not possess any cointegration. This indicates that the claim that the minimum wage increase will affect the domestic private investment has been reinforced by the authorities using their superior status to dominate the process of building a body of knowledge as well as to distort the truth so as to possess a control over the society. This is thus not a good-faith mistake but an effort of discourse fights on the economic unfairness and social-class discrimination, which is the root of Thailand's important structural problems.

Keywords: domestic private investment, empirical discourse analysis, Johansen Cointegration Test, minimum wage

"Discourse" and "Discourse Analysis"

"Discourse" is a social science and humanity terminology which Somkiat Wanthana had translated into Thai from Michel Foucault's concept more than 20 years ago (Mektrairat, 1989). Later, the understandings on "social text" and "social reality" constructed and maintained through languages (Alvesson & Karreman, 2000), which were scattered ideas in Foucault's works, were concluded and widely published in the academic field of Thai political science in the work of Chairat Charoensin-o-larn (2006) on "discourse" as a system and procedure in the creation/production of a symbol and definition of the society, which wrapped us in terms of knowledge, truth, power, or our own self. It also includes what we create to last and to be broadly accepted in the society until it becomes "dominant discourse".

By using the "power", polished and purely cleaned in the pattern of "specialized knowledge/expertise"

such as in science, medicine, and economics, through disciplines and customaries of various "experts" in the "academic discourse" on those relevant matters, "discourse" has been used as a sign or label for "a complex strategical situation in a particular society" (Charoensin-o-larn, 2006) in order to indoctrinate/cause a viewpoint, which is not truth, to eventually become "knowledge" and "truth".

As a critical analysis method, discourse has become very popular in different academic fields only after two decades after Foucault's death (Vighi & Feldner, 2007) in different meanings. It is used so often that there is no definition of the term, but simply assumption as it is for "discourse analysis" (Cheek, 2004). The gist of discourse is about studies and researches on method, procedures, sequences, and details in building a symbol and meaning to things wrapping us in the society in the form of discourse, including the operations and effects of discourse on specific matters (Charoensin-o-larn, 2006).

The development of humanities in early 1960s toward psychology in early 1970s (Van Dijk, 2007) showed that the "discourse analysis" was completely related to studies and analyses of the use of language by qualitative methodology (Hodge, Kuper, & Reeves, 2008), which were widely subject to questions on the negligence on scientific reasonableness (Freshwater, Cahill, Walsh, & Muncey, 2010). This was mainly to explain the language structure and textual duty, and to reveal the relationship between textual usage and social context (Stillar, 1998), instead of proof of truth and lies (Charoensin-o-larn, 2006).

The Relationship Between "Minimum Wage" and "Domestic Private Investment"

There have been criticisms on the Pua Thai Party's policy on the guarantee of the labor's minimum wage rate at 300 baht per day since the general election campaign on July 3, 2011, later such policy was contained in the policy statement of the Yingluck Shinawatra administration to the parliament on August 23, 2011 as the urgent policy to be implemented in the first year, and up until now. The public and private authorities stated that such policy would adversely affect the country's competitiveness, especially investment (*Post Today*, July 20, 2011) and export (*Matichon*, August 15, 2011).

The past research on *An Empirical Proposal on Power, Knowledge and Truth of Correlations Among the Minimum Wage, Foreign Direct Investment in the Industrial Sector and Export* (Jermsittiparsert, Sriyakul, & Pamornmast, 2011) proved by empirical data that the minimum wage rate did not correlate with foreign direct investment in the industrial sector and that the minimum wage rate correlated in the same direction to export with causality. The decision to implement such policy as campaigned, therefore, will not adversely affect foreign direct investment in the industrial sector or export.

The concept of "domestic private investment" is still left unproved. The authorities such as Tanit Sorat—Vice-chairman of the Federation of Thai Industries (2011) and Arthit Wuthikaro—Director General of the Department of Industrial Works (*Prachachat Turakit*, July 15, 2011), firmly argued that domestic private investment would be staggered and may be so severe that businesses would be closed. This was consistent with the news resource from the Ministry of Industry that in July 2011 there were only four factories which obtained permissions from the Department of Industrial Works to operate. The investment value totaled 209 million baht, decreasing from the same period of last year by 1,476 percent or 14.76 times, the lowest recorded in the history and even lower than that during the global economic crisis in April 2009, in which the total value was more than 4,000 million baht (*Thai Post*, August 1, 2011).

Objective

This research is conducted in order to analyze the relationship between the minimum wage rate and domestic private investment, using two indicators, which are import of capital goods and domestic machinery sale. This will reveal later whether the discourse created by the authorities, is actually the truth or just a suspicious viewpoint with a hidden agenda to make it a higher improper status of knowledge and truth.

Research Methodology

Data and Variables

The researchers chose to use the time-series data collected from the relevant and reliable agencies referred by the authorities and the public, covering the period of 136 months from January 2000 to April 2011, as the following variables:

(1) Minimum wage rate (WAGE), by using the minimum wage rate in Bangkok from the Ministry of Labor (2011). This is assigned as an independent variable of import of capital goods and domestic machinery sale;

(2) Import of capital goods (CAPITALIMPORT) at the fixed price of 2000 as an indicator of domestic private investment from the Bank of Thailand (2011). This is assigned as a dependent variable of the minimum wage rate;

(3) Domestic machinery sale (EQUIPMENT) at the fixed price of 2000 as the other indicator of domestic private investment from the Bank of Thailand (2011). This is assigned as a dependent variable of the minimum wage rate.

Data Analysis

Empirical Discourse Analysis or "EDA" is used to reveal the gap of discourse by advanced quantitative methodology, regression analysis so as to test the relationships between variables. Later, the Johansen Cointegration Test (Johansen, 1988, 1991) is employed to double-check such relationships whether they have cointegrations, using built-in computer software.

Results and Discussion

Minimum Wage Rate

The minimum wage rate (see Figure 1) from January 2000 started at 162 baht per day and continuously increased averaging at 0.40 baht per month. It has reached its maximum at 215 baht per day since January 2011.

Import of Capital Goods

Import of capital goods in January 2000 started at 41,844.34 billion baht and has increased and decreased in different intervals. However, considered in a big picture, the value of import of capital goods has had a trend to increase on average at 604.94 million baht per month, reaching the highest at 165,391.17 million baht in March 2011 (see Figure 2).

Domestic Machinery Sale

The value of domestic machinery sale in January 2000 started at 24,689.62 million baht and has increased and decreased in different intervals. However, considered in a big picture, the value of domestic machinery sale has had a trend to increase on average at 200.64 million baht per month, the lowest at 24,019.98 million baht in

April 2000 and the highest in March 2011 at 71,485.62 million baht (see Figure 3).
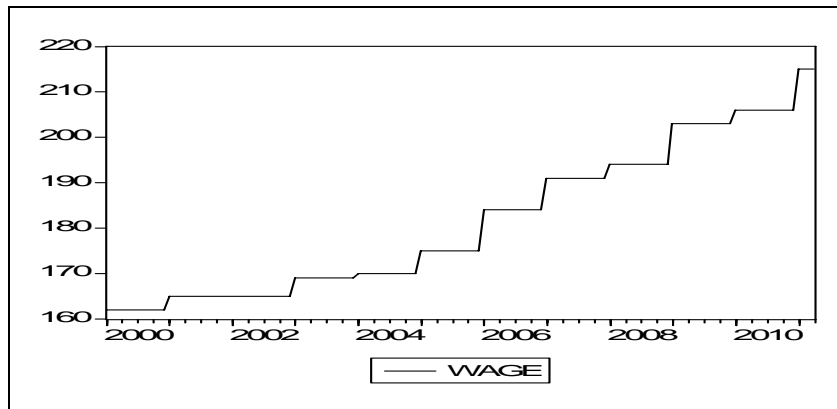
Figure 1. Minimum wage rate.
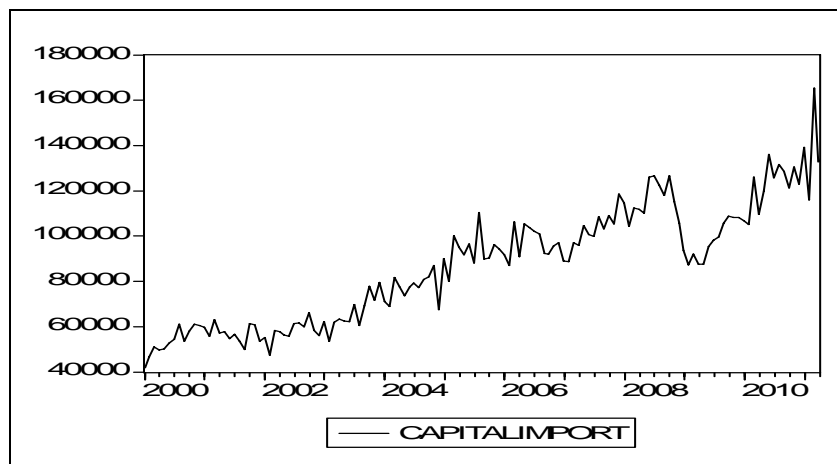
Figure 2. Import of capital goods.
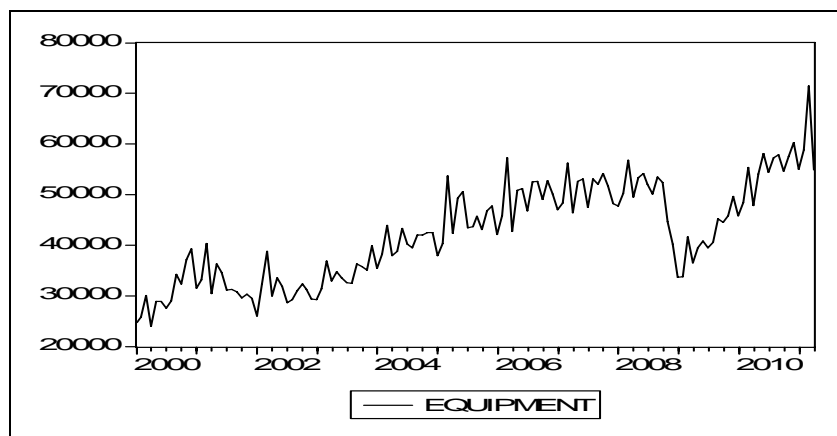
Figure 3. Domestic machinery sale.

Relationship Between the Minimum Wage Rate and Import of Capital Goods

At the beginning, the regression analysis shows that the minimum wage rate and import of capital goods have a relationship in the same direction with a statistical significance at 0.01 (see Table 1). Any change of the

minimum wage rate at every one baht will cause import of capital goods to change in the same direction for 1,411.12 million US dollars. The minimum wage rate can highly explain import of capital at 78.51 percent.

Table 1

Regression Analysis on Minimum Wage Rate and Import of Capital Goods

Variable	Coefficient	Std. error	*t*-statistic	Prob.
C	-168,990.3	21,425.23	-7.887444	0.0000
WAGE	1,411.116	121.6400	11.60076	0.0000

Notes. R-squared = 0.785103; Prob. (*F*-statistic) = 0.000000; and Newey-West HAC Standard Errors & Covariance (lag truncation = 4).

Relationship Between the Minimum Wage Rate and Domestic Machinery Sale

Table 2 demonstrates that the minimum wage rate and domestic machinery sale have a relationship in the same direction with a statistical significance at 0.01. Any change of the minimum wage rate at every one baht will cause domestic machinery sale to change in the same direction for 457.41 million baht. The minimum wage rate can explain domestic machinery sale at 58.14 percent.

Table 2

Regression Analysis on Minimum Wage Rate and Domestic Machinery Sale

Variable	Coefficient	Std. error	*t*-statistic	Prob.
C	-40,618.37	11,691.45	-3.474193	0.0007
WAGE	457.4104	66.69178	6.858572	0.0000

Notes. R-squared = 0.581420; Prob. (*F*-statistic) = 0.000000; and Newey-West HAC Standard Errors & Covariance (lag truncation = 4).

At this stage, the research can conclude that the discourse on the relationship between the minimum wage rate and domestic private investment created by the authorities, has the status of truth. Therefore, the implementation of Pua Thai's policy of guaranteeing labor's minimum wage rate at 300 baht per day will inevitably affect the domestic private investment.

Nevertheless, these relationships which seem to go along with a common sense might come from using non-stationary series in the regression analysis and could be only falsified relationships (Box & Jenkins, 1976). Consequently, the Johansen Cointegration Test is used to double-check the relationships.

Cointegration Between Minimum Wage Rate and Import of Capital Goods

The Johansen Cointegration Test shows that the minimum wage rate and import of capital goods do not have any cointegration at the significance of 0.05, meaning that the relationship in the above regression analysis of the two variables is only falsified (see Table 3).

Cointegration Between Minimum Wage Rate and Domestic Machinery Sale

Table 4 shows that as with import of capital goods, domestic machinery sale does not have any cointegration with the minimum wage rate at the significance of 0.05, meaning that the relationship found in the above regression analysis of the two variables is only falsified.

The advanced quantitative methodology demonstrates that the minimum wage rate does not have any relationship with import of capital goods nor domestic machinery sale, or in other words, the minimum wage rate has no relationship with domestic private investment.

Table 3

Johansen Cointegration Test on Minimum Wage Rate and Import of Capital Goods

Hypothesized No. of cointegration equation (CE)	Eigenvalue	Trace statistic	5 percent critical value	1 percent critical value
None	0.088687	12.16587	14.07	18.63
At most 1	0.021600	2.860673	3.76	6.65

Note. Trace test indicates no cointegration at both 5% and 1% levels.

Table 4

Johansen Cointegration Test on Minimum Wage Rate and Domestic Machinery Sale

Hypothesized No. of CE	Eigenvalue	Trace statistic	5 percent critical value	1 percent critical value
None	0.058845	7.944835	14.07	18.63
At most 1	0.009453	1.244179	3.76	6.65

Note. Trace test indicates no cointegration at both 5% and 1% levels.

Conclusions and Recommendations

In conclusion, the discourse or viewpoint on the minimum wage rate which is created and connected to the competitiveness of the country in domestic private investment as an opposite-diction relationship, not only shows the defects of the public authorities and the private sectors' arguments for themselves, but also depicts the efforts of establishing and growing a belief through the legitimacy of the authorities (Weber, 1997) through the use of language. Discourse, including a reproduction of it, is such a powerful and efficient tool (Van Leeuwen, 2008) to dominate and economically take advantage of and discriminate against people of different social classes, all of which are the root of Thailand's important structural problems. Such fights have been utilized by authorities to transform their own viewpoints into knowledge as well as truth.

Even though the empirical discourse analysis does not give end-of-the-tunnel findings of structure, strategy or procedure (Van Dijk, n.d.), as the original discourse analyzers are interested, this new way of discourse analysis has empirically revealed the discontinuity of logics and gaps of discourse, which are clearly the start of critical thinking methods to texts produced and reproduced by the authorities until they become familiar, overlooked and finally accepted in the society without questions or examinations.

With a wide application as well as prevention of (re)production of discourse by authorities, the analysis at the beginning period can be developed and sharpened in the future.

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HR Selection Distortions: A Theoretical Framework
for the Fiji Public Service

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Despite of being frequently perceived as a pertinent issue necessary to critically examine how incumbents are selected on merit, HR (human resource) selection distortions is typically ill-defined and poorly explained in much debate, hence, more precision in terms of contextualization of practice is needed. Through explaining and synthesizing the work of a number of scholars from different disciplines, the paper develops a theoretical framework for a meta-analysis, which begins with an exploration of the relationship among HR selection, networking and relational ties, employees' justice perceptions, group heterogeneity and worker performance in Fiji's public service institutions. The theoretical framework provides the leeway for the research questions to be answerable and the postulated hypotheses testable. However, more needs to be done to explain not only the nature and emergence of HR selection distortions but also the very real problems it faces in sustaining itself, let alone transform the hiring processes in Fiji's public service. The value of the paper lies in its theoretical innovation, drawing on a range of disciplines, and its attempt to situate HR selection distortions precisely, conceptually, theoretically, and practically.

Keywords: HR (human resource) selection distortions, network theory, Fiji, productivity and performance, justice perceptions

Dubin (1976) found that practitioners' and theorists' perception of theories differed; hence a strong theoretical model had great value but dissimilar of significance to both. Corporate managers and practitioners are mostly concerned with the accuracy of prediction of a theoretical model so as to guide their decision-making in conditions of uncertainty complemented by highly competitive markets. Further, theorists' interests are mostly directed to understand the preconditions and reasoning behind the predictions of the model. Hence, for them, a well grounded theoretical model allows for testing of the model and based on these tests, gaps that may indicate the vulnerability of the model rationalize the revision and upgrade of the model to increase accuracy of predictions (Dubin, 1976).

As per the above context, it is absolutely essential that Fiji public service managers not only are guided by some relevant theoretical framework so as to incorporate and instill elements of rationality to improve

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accuracy of decision-making and strategy formulation, but also must understand the preconditions, merits and rationality behind the predictions of the model and its framework. Hence it is anticipated that the current framework will be explained to the Fiji civil service via a policy implication chapter of the thesis in due course.

The first part of the paper introduces key theories and ideologies and spells out the significance of the framework. The second section of the paper outlines the key variables and their distinctive functions within the theoretical framework. It also elucidates the specific theoretical base and the validity of its assimilation to the grounded theory in the model, and crucial contributing potential to theory, practice and methodology. Most importantly, this paper outlines and discusses the functions and distinctions among the literature review undertaken to evaluate a key theoretical perspective in HRM (human resource management) for the following research question: Are selection distortions, introduced by hiring practices in Fiji's public sector associated with a decline in worker performance?

In their study, Rocco and Plakhotnik (2009) stated that as a type of manuscript, a theoretical framework synthesized existing theories, related concepts and empirical research to develop a foundation for new theory development. They further stated that presentation of a theoretical framework was crucial to quantitative method, theory driven study, which would have been designed to test a theory. On that note, the research design for the Fiji's public service institution's survey was mostly deductive where the model is dominant (see Figure 1), and the theoretical framework for this study has been designed as an enquiry into the social issues distorting the hiring processes in Fiji's public service.

The researcher selected the work of Harrington (2001), Gilliland and Chan (2001), and Acquaah and Eshun (2010) on social networks as well as theory on attribution, personnel selection and perceptions of justice (Cohen-Charash & Spector, 2001; Colquitt, 2001; Colquitt, Conlon, Wesson, Porter, & Ng, 2001) to provide the basis of the theoretical framework. The model by Harrington (2001) was specifically chosen because there were evident and abundance of affective ties in the culture and social systems of Fiji including community ties, extended family ties, the chiefly system, religious systems, business communities, etc. Likewise, there is also evident and abundance of instrumental ties in the culture and social systems of Fiji including: old boys' and girls' institutions, work mates, political colleagues, a labour market and culture with diversified heterogeneity.

The literature review for this paper canvasses HR (human resource) selection distortional issues identified in the literature on social networks and social rules theory and also on justice perceptions and applicant reactions. Specifically, key variables emerged from social network theory, i.e., instrumental and affective ties (Harrington, 2001) are assumed to have affected the employee's perceptions of justice of the hiring processes in the Fiji government departments under study. The differing perceptions of justice by employee may have positive or negative impacts on worker performance through group heterogeneity variables such as KSA (knowledge, skills and abilities), age and ethnicity. Justice perceptions are likely to correlate with group heterogeneity variables to trigger variations at levels of productivity and worker performance (see Figure 1).

In developing the theoretical framework for the study, key variables were either modified or added onto the model as outlined by Harrington (2001), Gilliland and Chan (2001), and Acquaah and Eshun (2001). The modified model adopted in the framework has new moderating variables (justice perceptions) and new intervening variables (group heterogeneity), and separates network ties into two sub-group independent

variables (instrumental ties and affective ties) and worker performance as new dependent variable (see Figure 1). Hence, the paper highlights emerging ideologies from different disciplines synthesized to formulate a theoretical framework of themes. It also addresses the significant differences of opinion among researchers, and importantly the authors of this paper's opinion about the validity of these differences. Further, the framework of themes has ascertained the critical areas in which little or nothing is established. These are the unanswered questions or gaps that provide the leeway for further exploration in the study.

The paper also presents a review and synthesis of the literature on HR selection distortions that mold the respective theories to prop and fabricate a theoretical framework (see Figure 1) which is specifically designed to organize, control and direct the research investigating distortions affecting HR selection in prominent institutions in Fiji's public service. Empirical materials, based on original secondary data were gathered from the Fiji civil service across different government departments. In addition, the theoretical framework has induced a survey to gather the necessary primary data of the research. In formulating the theoretical framework, the researcher ensured that it should have current relevance, be somewhat provocative, and a threat to the established ideologies (Page, Wilson, Inkson, & Meyer, 2003).
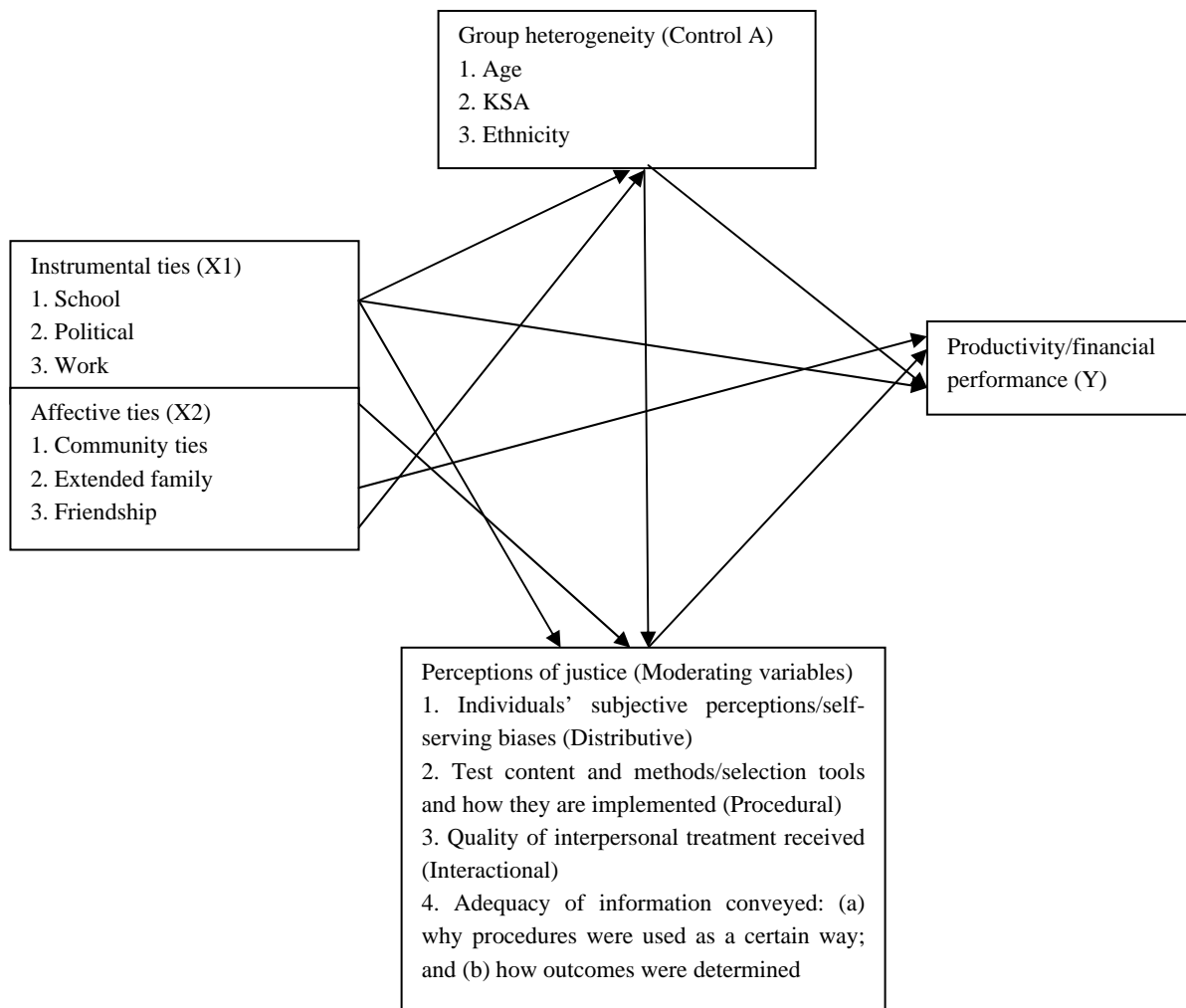
Figure 1. Theoretical framework for Fiji case model.

This study is important for the Pacific Region, developing countries and small micro-states because it will examine a public service institution's HR selection system in a country with a non-democratically elected government. Commodore Frank Bainimarama overthrew a democratically elected government in Fiji accusing them of being inefficient, ineffective, unproductive and racist, promising stakeholders that he and his regime would clean up the "faults" in the government systems.

Key HRM Challenges Facing Public Sector Organizations in Developing Countries

The key HRM challenges facing public sector organizations in developing countries today vary in accordance to their respective doctrines for survival and good governance taking into account their political and economic environment.

In his study, Schuler (2000) examined the circumstances surrounding the internationalization of human resources management and stated that in the new millennium, more and more companies were recognizing the importance of managing their human resources as effectively as possible and that it was almost impossible to do likewise without recognition and incorporation of the global context. In that regards, as the environment becomes more global, managing people also becomes more challenging, more unpredictable, uncertain and subject to rapid change and surprise. To that effect, Schuler (2000) reiterated that we were witnessing within HRM, the rapid appreciation for and development of all aspects of global and international activities and issues associated with and affected by HRM.

The findings by Schuler (2000) had a tremendous impact on the implementation and adoption of HRM strategies into the international community, especially the developing countries (DCs). In that regards, Schuler's (2000) findings laid the basis for promoting the ideology of being environmentally conscious as one appreciated the implementation and application of HRM, and the challenges that it proposed.

The theoretical framework and study presented in this paper will also contribute to the area of international and comparative HRM (Stavrou, Brewster, & Charalambous, 2010), given that Fiji is a developing country with developing public sector institutions. This paper will now introduce significant findings and challenges for DCs as per studies conducted in selected civil societies, providing the basis and justifying the formulation of the theoretical constructs for the Fiji government public service study.

Firstly, in their research on the Algerian civil service, Mellahi and Frynas (2003) found that under the immense pressure for survival, managers in the civil service had desperately searched for new ready-to-implement management concepts as their previous practices had become obsolete and inadequate in the new business environment. To give them a chance to survive in the fiercely competitive global markets, managers have no choice but to mimic western HRM practices. However, because of the inherent difficulty in transferring HRM practices between different cultures and the inability of Algerian managers to understand the potential problems that might be created by applying western HRM practices, the outcome is often subjected to immense scrutiny from stakeholders (Mellahi & Frynas, 2003).

This finding was crucial for the Fiji public service since internal pressures for reform emanated from government claims that the public enterprises were operating at unacceptably low levels of efficiency and effectiveness. Some of the reasons identified for this included a lack of accountability, over-staffing, corruption, cronyism, etc. (Appana, 1998). Additionally, globalization and other external pressures including donor agencies particularly the IMF, World Bank and the Asian Development Bank insistence on reforms played a key role in public service reforms in Fiji. This pressure cooker situation capitulates Fiji civil service managers

to implement reforms and it is only apparent that the "change agents" will dictate the reform specifics, discrediting the merits and relevancy of western HRM practices and theories. Hence, one has to critique the rationality of the implementation of western HRM practices and theories in these DCs like Fiji, and formulate a relevant framework to assess the merits and relevancy of HRM ideologies.

Further, Mellahi and Frynas (2003) found that while management justifications for the transfer of western HRM practices captured the economic and technical rationale for western HRM practices, they failed to identify local conditions under which these HRM practices might be transferred. This is again crucial for the anticipated Fiji study because the rationale is to identify those local conditions, and the impact of social network ties, to ensure institutions harness and not constrain the application of western HRM practices. HRM practitioners in developing countries like Fiji may need to modify policies so as to properly suite the infrastructure and capability potentials. Hence, the study has the potential to upgrade, develop and/or modify HR selection policies in the Fiji public service, which is critical for policy reforms, effective and efficient operations of state institutions and improvement of public officer's performance and productivity.

In their study, Tessema and Soeters (2006) highlighted that organizations needed to effectively manage their human resources if they were to get the maximum contribution of their employees, and their study critically examined how, when and to what extent HR practices affected worker performance level. Their research on the Eritrea civil service found that in spite of the implementation of civil service reforms, the critical challenge they faced was how to fully realize the potential of their human resources to enable civil service organizations to operate effectively (Tessema & Soeters, 2006). Generally speaking, they identified that the environment within which Eritrean civil servants were employed did not seem to attract, motivate and retain competent civil servants, hence the availability and utilization of capable civil servants were of utmost importance. Kim and Hong (2006) supported the theory of Tessema and Soeters by stating that to enhance government performance and national development, efficient management of human resources is essential. To that effect, the HRM synthesis advocated in their report proposed a public service that was impartial, professional and responsive. This finding has significant implication to the Fiji public service and the gauntlet is thrown down now before the managers of the civil services and government as a whole so as to ensure that a civil service reform environment is molded, given Fiji's recent period of the political, economic uncertainties and instability.

In their study on the Maltese public service, Cassar and Bezzina (2005) highlighted another significant challenge facing public sector organizations in DCs. They found that the structural and operational changes in the Maltese public service were spearheaded through the European Union (EU), due to Malta's accession to the EU. Hence because of the pressure from the EU, the Maltese Public Service Reform Commission Report (MPSCR) mandate was primarily to execute structural and policy changes. The attempt to change old mind-sets of civil servants (Hewitt, Wangwe, & Field, 2002) was relatively ignored, except for re-training recommendations. Cassar and Bezzina's (2005) finding expounded Mellahi and Frynas's (2003) theories and asserted the ideology that when "change agents" dictated reforms, crucial variables that needed to be addressed were often overlooked deliberately.

The critical challenge facing public sector organizations in DCs from the Maltese civil service study is "people must change before institutions can". This is again a crucial finding for the Fiji public servants, where the civil servants' mind-set has to be changed to fully embrace newer ideologies, good governance and for the

purpose of this paper, HRM concepts that improve and sustain worker performance.

Pari and Frame (2007) strengthened Cassar and Bezzina's (2005) work in view of their findings on a study done on the Iranian public and private sectors. They elaborated that a distinctive challenge facing the Iranian public service was their hiring processes. They have specifically identified that a constraint in the Iranian public service recruitment program is nepotism or hiring someone who is known to someone in the organization. They found out that this was due to the Iranian national culture of being family-oriented and a distrust of outsiders. It is believed that a known person will be more committed and loyal to the organization than a complete stranger (Pari & Frame, 2007). This finding has been incorporated into the theoretical framework for the Fiji study and expanded to include networking relationships (Harrington, 2001). It is also critical for the Fiji civil service because of the collectivist nature of the culture and family-oriented societal infrastructure.

The Public Service Commission (PSC) of Fiji is a critical player and institution in this study because it sets the parameters (policies and guidelines) within which hiring practices, performances and productivity are implemented for those public service institutions under survey.[1] Significant HRM challenges faced by the Fiji PSC includes incomplete complementary reforms in the public service, political instability and investment uncertainty, loss of human capital through movement off-shore, bad governance and inefficient public sector resources management (Reddy, Prasad, Sharma, Duncan, & Vosikata, 2004). Given the nature of local Fiji conditions and HRM challenges faced by Fiji public service managers, the theoretical framework was purposively modeled to act as a vehicle to examine the impact of networking relationships and justice perceptions of current civil servants on the hiring processes in Fiji's public service. Networking relationships and ties are part and parcel of Fiji's culture and have assumed to infiltrate Fiji's labour market, especially the civil service.

Justice Theory: Employees Perceptions

The literature review conducted so far has revealed that justice perceptions of HR selection decisions and procedures by existing employees have not received much attention since much of the focus has been directed to applicant reactions (Gilliland, 1993; Gilliland & Hale, 2005); hence this gap in the literature justifies the formulation of the theoretical framework (see Figure 1) in this paper. Bearing in mind that organizational justice addresses perceptions of fairness in organizational decisions and decision-making procedures, Gilliland and Chan (2001) expounded on Gilliland's (1993) study by stating that the perceptions of fairness can be divided into two major categories: fairness of outcomes (distributive justice) and fairness of processes (procedural justice). An additional type of justice was later on added to the two justice constructs as researchers realized that people also considered interpersonal treatment to be a form of justice and this was termed "interactional justice" (Gilliland & Hale, 2005).

The above stated constructs were incorporated into the theoretical framework for the Fiji survey where employee's distributive and procedural justices were assessed. The study by Gilliland and Chan (2001) was relevant to the Fiji study and theoretical framework because justice expectation variables would be examined as potential moderating variables to the relationship between some independent (network ties) and dependent variables (workers' performance). Further, this finding is also crucial in the examination of the hiring processes

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[1] Retrieved from http://www.psc.gov.fj.

in Fiji's public service because the perception of interpersonal treatment, whether they may be positive or negative, is crucial in the measurement of applicant's perception of justice in the HR selection models in Fiji's public service.

The instrument in the study by Gilliland and Chan (2001) has been adapted to the theoretical model as the moderating variables (see Figure 1). After analyzing a set of other theoretically plausible models, Gilliland and Chan's (2001) model is the best of the set of possible models, since its four specific instruments are particularly important to the advancement of justice research and the four instruments included in the model are individuals' subjective perceptions/self-serving biases (distributive), test content and methods/selection tools and how they are implemented (procedural), quality of interpersonal treatment received (interactional) and adequacy of information conveyed.

In developing their theory of organizational justice, Bell, Ryan, and Wiechman (2004) examined the association between organizational justice and applicant perceptions in a HR selection environment. This piece of literature supports the work of Gilliland and Hale (2005) and elaborates the experiences of justice perceptions and its likely impacts on HR selection. They examined and tested the three sources of expectations—direct experience, indirect experience and other beliefs to identify the determinants of justice expectations in a HR selection context. Hence, their research design was formulated around three underlying assumptions. The first assumption was that justice expectations in a selection context was derived and greatly influenced by an applicant's past experience in the same institution, taking into account his/her personal characteristics and the environmental influence. The next assumption was deduced around the idea that justice expectations in a selection context was derived and greatly influenced by a person's existing belief about an organization, taking into account his/her personal characteristics and the environmental influence. Lastly, they stated that the final assumption in the article was that justice expectations in a selection context were greatly influenced by an applicant's indirect experience in the same institution, taking into account his/her personal characteristics and the environmental influence.

The relevancy of the research of Bell et al. (2004) on the theoretical framework for the Fiji public service study is quite substantial for the following reasons: Firstly, an applicant's past experience in a hiring environment in one of the public sector organizations in Fiji may influence his/her current justice perception level. Further, a person's extant belief about an organization, taking into accounts his/her personal characteristics and the environmental influence, is a strong determinant of justice perception and this is crucial for the Fiji study. Lastly, an applicant's indirect experience in the same institution, taking into account his/her personal characteristics and the environmental influence, for example, he/she may not be formally advised as to the reason why he/she is not selected for the job, has significant implications on his/her justice perceptions.

Social Networking Theory: Networking Relationships

This aspect of the framework highlights the importance of relationship ties and networking relationships in a public service institution hiring processes and how that subsequently impacts worker performance, drawing on the studies by Harrington (2001) and Acquaah and Eshun (2010). Relationship ties are the condition of being related, connected or associated through the same object of interest.

It has been noted that Harrington (2001) examined the impact of net instrumental ties through task orientation and group heterogeneity on performance, rather than selection decisions. The significant gap

emerging from her work was capitalised by this study and subsequently expanded this model to critically examine the influence of net instrumental ties on HR selection decisions taking into account employee's justice perception of the influence. Further, her studies was also utilised in the theoretical framework to showcase how employee's justice perceptions control group heterogeneity variables to induce the relevant worker performance level. She classified network ties into two ideal types: instrumental bond, which is the network ties among co-workers, and affective bond, which is the network ties based on similarity/attraction processes, such as those between family and friends.

Agneessens and Wittek (2008) supported Harrington's (2001) ideology by stating that social relationships improved individual and organizational performance, because they positively affected the satisfaction and well-being of employees. Further, when associating Agneessens and Wittek's (2008) work with Harrington's (2001) study, one may deduce that social relationships or some form of network ties may be transformed into social capital which was important for individual and organizational performance. This finding is crucial for the Fiji public services study because of the heterogeneity in Fiji's labour market and the potential within the heterogeneity ethnicity mix.

Further, key variables emerging from social network theory: instrumental and affective ties are assumed to have affected employee perceptions of justice of the hiring processes in Fiji's public service (Harrington, 2001). The differing perceptions of justice by employees may have positive or negative impacts on worker performance through group heterogeneity variables such as KSA, age and ethnicity. Employee justice perceptions are likely to correlate with group heterogeneity, i.e., KSA, ethnicity and age to deduce variations at levels of worker performance and subsequently organizational productivity (see Figure 1).

Acquaah and Eshun (2010) complimented Harrington's (2001) research findings and reinforced the theoretical framework through their research theme. They found that only managerial social networking relationships with top managers of other firms, government bureaucratic officials, and community leaders enhanced organizational performance. The ideology entrenched in Acquaah and Eshun's (2010) work has identified a gap to be capitalised in the Fiji government research via the theoretical framework in which a situational analysis of all employees irrespective of organizational status will be conducted. Further, they found that the effect of networking relationships on performance was not always positive but contingent on organizational as well as environmental characteristics; hence firms could not establish networking relationships with other firms without considering the characteristics of those firms and the environment under which they operate. This finding is also crucial for the anticipated study on Fiji civil service because if positive networking relationships are contingent on an organization's internal and external environment, this will have a significant bearing on the anticipated performance. Likewise, negative networking relationships are also contingent on an organization's environmental situations.

Hence, the major propositions of the study accentuated from these findings allow the theoretical framework to direct the research question of the study to the postulated hypotheses which are as follows:

Hypothesis 1

The positive impact of instrumental ties on worker performance will be greater in organizations with perception of justice than in organizations with perception of injustice.

Hypothesis 2

The negative impact of affective ties on worker performance will be greater in organizations with

perception of injustice than in organizations with perception of justice.

Group Heterogeneity

Davidson and Friedman (1998) stated that demographic characteristics such as ethnicity, age and competency levels may be likely to influence an individual's expectations of justice because they captured some issues between groups' variability in past fairness experience and beliefs' systems. This will also provide further insight into the consequences of justice expectations, particularly how it affects employee performances and productivity.

In their study, Ployhart and Ryan (1997) used the organizational justice and attribution theory frameworks as their discipline base to understand the processes by which applicants perceived and reacted to selection procedure and decisions. The theoretical constructs for their study included adapting portions of Gilliland's (1993) model of organizational justice to examine applicant's pre-application and post-offer perceptions. Ployhart and Ryan (1997) argued that each stage of the selection decision may present different types of perceptions and reactions and the relationships between process fairness and behavioural intentions at both the pre-application and post-offer stages of the selection process had not been examined with actual applicants and that was one of the focuses in the study. They further stated that behavioural intention variables used in the study were chosen because they have been studied in past research and had practical significance to organizations. Ployhart and Ryan's (1997) work complimented and reinforced Davidson and Friedman's (1998) contribution to the theoretical framework of this study in stating that employees perception of the selection procedure and decisions of the organization would correlate a similar reaction with the heterogeneity variables (KSA, age, ethnicity, etc.).

Further, part of the theoretical constructs of their study included Weiner's (1986) attribution frameworks. Attribution or people's causal ascriptions of events and behaviours are a fundamental part of social perception, and are considered "the underpinnings of further judgments, emotional reactions, and behavior" (Fiske & Taylor, 1991, p. 54). Attributions are important because what a person perceives to be the cause of some event can influence how that individual will respond to the event (Weiner, 1986). In adopting Weiner's (1986) theory, Ployhart and Ryan (1997) argued that the theory made clear predictions about how an individual should respond to a selection decision and also provided information about the reason why the reaction occured (i.e., the nature of causal ascriptions). Ployhart and Ryan's (1997) research design included combining portions of Gilliland's (1993) model of organizational justice and Weiner (1986)'s attribution framework purporting to explain an applicant's reactions of the organization's selection decisions from an organizational justice and an attribution framework. As per Gilliland's (1993) organizational justice model, the variables were initially operationalised from two starting stances: process fairness to measure pre-application reactions and outcome fairness to measure post-offer reactions.

Weiner's (1986) attribution framework is critical in assessing the impact of heterogeneity variables in inducing worker performance, given the employees perception of HR selection decisions and procedures. An applicant's knowledge of the selection decision influences the outcome regarding that decision and people will spontaneously search for causal ascriptions when an outcome is unexpected, negative, or important (Wong & Weiner, 1981). The individual will also have a positive or negative affective reaction to the outcome (Kluger & Rotherstein, 1993). Hence, the three causal dimensions of attributions were specifically measured and these included the variable of locus of control which was initially examined to ascertain whether a cause was

perceived to be due to factors internal or external to the person. The second variable assessed is stability, which indicates the extent to which the cause is seen as stable or unstable in the future (Weiner, 1986). Finally, the third variable, controllability, was also assessed to examine the amount of control the individual has over the outcome (Weiner, 1986). Expectations, self-perceptions, and intentions were then determined as a result of the levels of these dimensions, and there were differential relationships between these variables for a selection applicant. Even though Brockner and Wisenfield (1996) summarized a large body of literature that had found that procedures mattered most when outcomes were unfair or undesirable, an important finding in the work by Ployhart and Ryan (1997) suggested the opposite, i.e., that procedures mattered most when outcomes were perceived as fair.

The study of Ployhart and Ryan (1997) and Weiner (1986) is relevant to the Fiji public service study because of the following issues: Firstly, an outcome of the study highlights that procedures matter most when outcomes are perceived as fair. This finding has important implications to the current study because the perceptions of the key stakeholders to the hiring process and in particular the hiring practices play a crucial role in the build-up of their respective justice perceptions. Secondly, the process of gathering applicant's pre-application and post-offer perceptions is crucial for the Fiji case study scenario because it will ascertain whether Fiji's public sector has been engaging in a recruitment process and not selection process. This issue ties in well with the situational analysis are organised and spearheaded by the theoretical framework in this paper because employees' perception of current and past HR selection processes will be analysed.

Worker Performance and Productivity

As earlier stated, Harrington (2001) examined the impact of net instrumental ties through task orientation and group heterogeneity on performance, rather than selection decisions. This study expanded her ideology to critically examine the influence of net instrumental ties on HR selection decisions taking into account employee's justice perception of the influence. Further, her studies were utilised in the theoretical framework to showcase a theoretical stance on how employee's justice perceptions control group heterogeneity variables to induce the relevant worker performance level.

In her study, Greiling (2006) stated that promoters of performance measurement were convinced that performance measurement can greatly contribute to an efficiency boost in the field of public service. Her study examined the potential offered by performance management and performance-based contracting for increasing the efficiency of public service delivery. However, she found that the mere existence of performance measurement does not automatically produce an increase in efficiency as a side effect. She reiterated that whether performance measurement would work as an add-on for rationalization can be doubted from the standpoint adopted by Max Weber, and it may even be more likely that the stability and predictability of public service delivery would decrease with the introduction of performance measurement and performance contracts. This finding is crucial for the Fiji public service survey and justifies the importance of analyzing the current performance measurement instruments employed by the Fiji PSC, as per the direction of the theoretical framework.

Further, Greiling's (2006) study concentrated on the question whether performance measurement led to increase efficiency of public service delivery. In that context, she stated that efficiency was understood as a ratio of output to input. Hence, a public service is efficient if a defined output is reached by

minimizing the input factors, or if, given a defined amount of input factors, an output maximum is reached. All in all, a satisfying efficiency level is achieved if the benchmark for a feasible input/output ratio is met.

The theoretical framework presented in this paper also guides the researcher to analyze and formulate a performance benchmark which should be utilised by the Fiji PSC. Courty and Marschke (2004) stated that an important challenge in the design of performance measurement, accountability, and incentive systems was the establishment of relevant benchmark levels of performance, also known as performance standards. The construction of performance standards is central to the legitimacy and success of performance measurement systems. Courty and Marschke (2004) also stated that performance standards established benchmarks to guide the evaluation of actual performance and to construct measures of value-added, and performing above or below the standard can have important short-term consequences (rewards, budget revision) as well as long-term ones (promotion, structural reorganization).

As of now, the Fiji PSC has set in place worker performance benchmarks for civil servants; however, the efficiency of these worker performance instruments needs to be critically examined. The Fiji PSC performance assessment for contract officers (PACO) initially analyses workplace assessment using the following variables: punctuality and attendance, interpersonal communication, flexibility, commitment to PSC values and code of conduct, presentation, team relationship, and these are measured on a five-point Likert scale. Further, worker performance is then assessed using the following variables: professional attributes, supervisory and leadership, skills and abilities, standard and quality of work performance, initiative and resourcefulness, judgments, attitude, responsiveness and qualification, training and competencies.[2]

However for those who were appointed prior to 2009, their performances were assessed using the Annual Confidential Report (ACR). The ACR of the public servants is written with a view to adjudge their performance every year in the areas of their work, conduct, character and capabilities. By convention, the system of writing confidential reports has two main objectives. First and foremost is to improve performance of the subordinates in their present job. The second is to assess their potentialities and to prepare them, to be filled by the reporting, reviewing and accepting authorities in an objective and impartial manner. The current ACR of the Fiji PSC are using the following variables to assess worker performance: quality of work, quantity, knowledge required by the job, initiative and resourcefulness, judgment, degree of supervision required, responsibility and ability to communicate.[3]

As per the above, the study on Fiji's public service will critically examine worker performance and productivity particularly on the institutions under examination, specifically analyzing the effectiveness of the current performance and productivity measurement mechanisms. The ACR and PACO format will be assessed in terms of how they accurately measure the tasks and roles of appointed officers. Hence, the essence of critiquing a model is to build on the founding principles so as to formulate newer models which are relevant to the current circumstances where organizations are operating with the view of not only meeting but also exceeding customer expectations. These newer models provide the basis for the formulation of organization polices and regulations to ensure that inputs are efficiently utilized, costs contained and productivity enhanced and sustained.

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[2] Retrieved from http://www.psc.gov.fj.
[3] Retrieved from http://www.psc.gov.fj.

Practicable Contribution of the Framework

The theoretical framework introduced in this paper has set the parameters to critically analyse the HR selection processes in Fiji public service and examine pieces of legislation that have constitutional significance for the Fiji government and in particular the Fiji PSC. Hence it is only obvious that the researcher begin with the analysis of legislations governing HR selection in Fiji's public services.

In their study, Konig et al. (2010) highlighted that the scientist-practitioner gap in personnel selection was large. Thus, it is important to gain a better understanding of the reasons that make organizations use or not use certain selection procedures, rules and regulations. Based on institutional theory, they predicted that six variables should determine the use of selection procedures: the procedures' diffusion in the field, legal problems associated with the procedures, applicant reactions to the procedures, their usefulness for organizational self-promotion, their predictive validity, and the costs involved. Klehe (2004) argued that the general predictions made by institutional theory can also be applied to the use of personnel selection procedures. She further stated that if the use or non-use of selection procedures is considered to be one specific strategic decision that an organization can make, then institutional theory should help to explain which procedures are used and which are not.

Konig et al. (2010) reiterated that the idea that organizations tried to achieve legitimacy had major implications for personnel selection because it predicted that legal considerations, applicant reactions, and the extent of diffusion of a procedure in the field should be important aspects of HR selection. They further stated that institutional theory can also be used to derive the hypothesis that organizations may consider HR selections as an opportunity to promote themselves. Schuler (2000) clearly stated that under institutionalism theory, organizations operated in a manner consistent with the rationalized myths that would garner them legitimacy in their external environment. In this respect, it is assumed that once justice is perceived in the HR selection model, stakeholders in the external environment will render legitimacy, hence exerting trusts in management and overall operations.

This issue has important implication for this paper and the Fiji study because Commodore Frank Bainimarama overthrows a democratically elected government in Fiji accusing them of being inefficient, ineffective, unproductive and racist, promising stakeholders that he and his regime will clean up the "faults" in the government systems. In other words, in December 2006, the perceived illegality of the HR selection processes of the then government of the day is assumed to have triggered the overthrow and change of government.

Klehe (2004) also stated that if organizations faced legal claims against them, this could mean serious damage to the legitimacy of the organization, not only due to losing a case in court, but also due to financial losses. She also stated that legal considerations could also produce fear in organizations that the use of certain selection procedure may not be legally defensible. In their study, Beatty et al. (2003) compounded the argument by stating that HR had a fiduciary responsibility to ensure that laws were followed. Failure to do so puts the organization and government for that matter in legal jeopardy. The above has important implication for the current regime in Fiji, and importantly the perceptions of the Fiji public servants on the current HR selection processes employed by the government. Over the years, different stakeholder perceptions and interests of the Fiji government public policy, rules and regulations triggered the period of political instability which began in 1987.

Theoretical Framework of the Future

Bell et al. (2004) proposed certain theoretical limitations which would have positive implications for future research; firstly, that "future research is needed to better understand exactly how expectations fit into the larger organizational justice framework and the implications of justices expectations for understanding and enhancing applicant perceptions". In addition, they also proposed that further studies need to be done on the role of expectation strength in determining the effects of justice expectations because as the strength of an expectation increased, so did its impact on an individual's cognitions, attitudes, and behaviours.

The relevancy of the research of Bell et al. (2004) on a future theoretical framework is quite substantial for the following reasons: Firstly, an applicant's past experience in a hiring environment may influence his/her current justice perception level. Further, a person's extant belief about an organization, taking into account his/her personal characteristics and the environmental influence, is a strong determinant of justice perception. Lastly, an applicant's indirect experience in the same institution, taking into account his/her personal characteristics and the environmental influence, for example, he/she may not be formally advised as to the reason why he/she is not selected for the job, has significant implications on his/her justice.

Further, Ployhart and Ryan (1997) have highlighted that it was probable that future researchers may examine how process fairness was related to the diagnosticity of procedural information (for example, fair procedures were more diagnostic), i.e., the more diagnostic a procedure was, the higher the probability that it was fair. They also revealed that "future research should attempt to more directly examine possible theoretical reasons for the interaction between process fairness and the selection outcome (or perceived outcome) on self-perceptions, perhaps by considering the role of 'self-verification'".

It is also prudent for future researchers to dwell further on the theoretical framework presented in this paper and conceptualise on specific variables that integrate the specific agents and elaborate on their theoretical stance. Rocco and Plakhotnik (2009) stated that a conceptual framework related concepts, empirical research, and relevant theories to advance and systematize knowledge about related concepts or issues. They further stated that such a framework would help researchers define the concept, map the research terrain or conceptual scope, systematize relations among concepts, and identify gaps in the literatures. Hence, since the current study concentrates on the public service, it would be prudent for future researchers to examine public sector institutions.

Conclusions

This integrated literature review has examined a selection of published knowledge about HR selection distortions and in particular a theoretical framework stance. The intention of mapping the framework is to organise and conceptualise it in regards to whom the theorists are and in which sites of engagement they create. Likewise, our framework has highlighted an effort to describe the significant contribution of each theory in formulating the model. Using the appropriate framework will improve the quality of manuscripts and increase the likelihood of favourable critiques by reviewers and editors.

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The Intellectual Capital in Urban Strategic Planning

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The most distinctive feature of local authorities, namely the creation of public value in a financially sustainable way, is becoming increasingly complex and dynamic. This is due to many reasons, but mostly because creating local public value is significantly affected by the roles played by many other actors, including citizens, businesses, other public authorities and non-profit organizations. In this regard, both local authorities and the other social players find critical success factors in their knowledge resources, which generate at the same time competence and confidence. Therefore, for local authorities the development of their intellectual capital as well as that of their community of reference (i.e., their constituency) are qualifying performances and must be included in their system of governance. In this context, urban strategic planning takes on increasing importance. This paper investigates whether and how intellectual capital is developed within the set of local governance tools and in particular within the urban strategic plans drawn up by the regional capitals, with the aim of bringing out the degree of interest and commitment on the subject of the main Italian local authorities. This analysis also offers an opportunity to identify some critical points and provide some useful guidance on the contributions of urban strategic planning and knowledge management to the creation of local public value.

Keywords: local authorities, intellectual capital, local public value, urban strategic planning, public governance

Urban Strategic Planning and the Creation of Local Public Value

In recent years, several urban strategic planning initiatives have finally started spreading across Italy. These experiences, whose aim has been to test more effective ways to deal with complex governance problems such as those related to socio-economic development[1], have emerged as one of the methods and instruments of local governments around the second half of the 1990s—the first urban strategic planning initiative was launched in Turin in 1998. This shows a considerable delay compared with other national contexts, since by the end of the 1990s many industrialized countries had already gained significant experience in the field (Ave & Corsico, 1994; Gibelli & Curti, 1996; Vecchi & Gioioso, 2007).

The first generation of strategic plans was to be found in France and the United States in the 1960s and 1970s. It consisted of instruments for structural planning, predominantly of regulatory nature, that were large in scope, supported by a strong quantitative component and with a hierarchical-prescriptive character. The self-referential and rigid nature of this model, unable to grasp the inevitable dynamics of the socio-economic contexts they referred to, determined their decline.

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[1] Retrieved from http://www.recs.it.

A second generation of strategic plans was then introduced in the US at the end of the 1970s and adopted in the following decade in several European countries, mostly in the United Kingdom and in Central Europe. They consisted of solutions that aimed at adapting the methods and instruments of the business sector to the public sector, thus embodying notions of pragmatism, flexibility, openness, and negotiation.

Some of the limitations of this model, mainly concerning a too casual and utilitarian application of its principles, favored the birth during the 1990s of a third generation of strategic plans. One model in particular emerged sought a balance and synthesis of the two previous approaches, combining the demands for rigor (especially in the protection of the environment) and flexibility (in support of development opportunities) through decision-making procedures that were both network-like and visionary.

The delay that Italy experienced in adopting urban strategic planning had at least the advantage of happening when it was possible to rely on a mature reference model (i.e., the third generation model), which drew on the experience, successes and failures of the earliest models and was oriented toward a sustainable development governed by partnership types of relationships.

Moreover, the historical period in which these first steps were implemented was not random because of a variety of reasons partly correlated with each other. First, during the 1990s it became apparent, even in Italy the impact of momentous economic and social changes (notably, globalization) and the new and different problems they posed to urban governance. In parallel, as part of the administrative reforms initiated by Law 142/1990, the roles and functions assigned to local authorities gradually expanded and intensified, along with the growing independence they were granted. Finally, it was also a time of profound crisis for politics or, more properly, for political parties, with the disintegration of the major parties who had occupied the scene in the decades before. This called for the identification of original solutions to build consensus in local governments.

Overall, strategic planning can be useful to meet the distinctive function of local authorities, which can be expressed in terms of creating public value in an economically efficient way (Moore, 1995; Deidda Gagliardo, 2002). This function integrates the need to effectively and efficiently meet the public needs of citizens, thus contributing to the socio-economic development of each community and territory, with the achievement of long lasting and dynamic conditions of economic and financial equilibrium, thus acquiring and efficiently using the increasingly scarce and therefore precious public resources.

This function, as we have already had occasion to observe (Fontana, 2009), is defined both in terms of specificity and complexity, starting from the possible convergence, and divergence between the creation of public value and institution equilibrium.

Indeed, creating a positive difference between the benefits that are produced and the sacrifices that are required to citizens is not in itself a guarantee of cost management, not only because benefits and sacrifices are partly economic, but mostly non-economic in nature (Sostero, 2003), but also because they often correspond to accounting records of opposite sign.

After all, cost management does not necessarily imply the creation of public value, due to the multiple modes of remuneration of local authorities, which only partly require users to pay the nominal value of the services they are offered. Most often, local authorities are rewarded through political prices or taxation, either direct or transferred. Nevertheless, the creation of public value and cost management need to be pursued jointly: The non-transitory absence of either one or the other would in fact deprive local authorities of their own reason or even possibility to exist.

To continue, this function is characterized by the marked degree of diversification of the activities of local

authorities (Borgonovi, 2004): Let's just think of the plurality of functions performed and of the services produced, which are very significant in terms of areas and groups to be targeted, of content and modalities of intervention and finally of the multi-disciplinary and multi-sectoral skills and of the composite nature of the problems to be tackled (which often involve aspects that are at the same time environmental, social, economic and technical).

Even the targeted geography is variable and often does not correspond to the administrative boundaries. One classical example is to be found in the field of transport and in the public services of water distribution or tourism promotion.

Even more important, in terms of operational complexity, it is then the framework of the relationships of opposite sign, sometimes co-operatives and sometimes competitive, that comes into play. The governing bodies of local authorities are the expression of the ideas, values and claims of only one section of the community. Moreover, in many cases there is no overlap between the users who use the services and products of a given local authority and those that contribute to their funding. Finally, even among the various actors that use those services there are often divergent interests, which are functionally antagonistic (it is enough to consider for instance consumers and businesses, pedestrians and motorists) or compete in the allocation of scarce resources. The systemic process of bringing together different expectations is therefore a fundamental and critical condition for the creation of local public value.

It is not to mention the already described dynamism that significant changes in the socio-economic, scientific-technological, and political-cultural domains impress on public needs and public policies (Anselmi, 2005). This means that the very identity of the city, of the territory and of the local community is often questioned, if not completely doubted, because of phenomena that gives it uncertainty and discontinuity. At the same time, local authorities are assuming roles and features that are more and more composite: the productive role that pertains to them in their quality of service units, the directing role that belongs to them in their quality of public holdings, and the regulatory role that fits them in their quality of local governing bodies.

No less significant are the complementary institutional, political and business dimensions of local authorities (Buccellato et al., 2004). The institutional dimension refers to the set of rules that constitute its statutory principles, defining both the areas of activity and the degree of autonomy (Zangrandi, 1994). The political dimension refers to the systematic search for consensus that characterizes all government entities, which then has to be harmonized with the managerial function expressed by the administrative and technical structure (Volpatto, 1987; Farneti, 1995; Mussari, 2002). They both affect the business dimension, influencing both the form of cost management and the creation of local public value.

Last but not least, it should be noted that socio-economic development only partially depends on local authorities. Equally determinants are the roles played by other actors in the system—households, businesses, other government entities and non-profit organizations—and the contributions they make in terms of resources, expertise, ideas and actions (Kickert, 1997). They constitute a rather fragmented framework, but their attitudes and behaviors nevertheless affect the output produced by the management of local authorities and more generally the process of creation of public value. It is therefore critical that local authorities adopt a "public governance" approach, namely a willingness and an ability to play the important role in attracting, involving, monitoring, and promoting the activities of other social actors, facilitating and positively orienting, in a collaborative and synergistic sense, their individual and collective development, thus contributing to generating and at the same time drawing upon the social capital of the whole community (Slope, 2000; Putnam, 2005).

The above-mentioned features of specificity and complexity that characterize the function of local authorities are the main reasons for the growing interest in urban strategic planning (Mazzara, 2009). The latter, in fact, may offer a useful contribution to local government, as long as it is set and carried out in an authentic and substantial way. It is necessary that the urban strategic plan does not limit itself to only contextual and background (internal and external) analyses, even if it is to a degree indispensable. It also needs to identify a clear model of development that is guided by a long-term and far-reaching vision and is able to make clear the meaning of its foundational choices and, on this basis, identify possible courses of action, projects to be given priority and related business solutions. More specifically, the effectiveness of the urban strategic plan requires the acceptance of some conditions appropriate to both the object and the subjects of planning.

With regards to the contents of the plan, it becomes necessary to have a selective and integrated logic, which is both far reaching and perspective, sustainable and flexible (Rur/Censis, 2006; Tanese et al., 2006). A selective approach, limited to a few themes, objectives and projects that are relevant to the socio-economic development of the territory and the community, is essential to focus attention, resources, energies and actions on crucial and decisive issues, which are able to have a greater impact on future scenarios and avoid instead dispersion and dissipation.

At the same time, an integrated approach that is mindful of the interdependence and co-determination of the various policy interventions is essential to make them consistent and coordinated, to generate useful synergies and to create systemic value. From a space-time perspective, a far-reaching and long-term horizon is necessary to take account of complementarities (both as sources of constraints and opportunities) between different regions and various levels of government, to achieve important goals, to coagulate significant resources, and to enable innovative processes, overcoming the shortsightedness and constraints of each single administrative mandate.

The sustainability and flexibility of the contents of the urban strategic plan are further key features to be taken into account. The former, which is the result of the beneficial correlation between goals and resources, makes the urban strategic plan rational and realistic, at once ambitious and feasible, avoiding idealistic temptations as well as the propensity to give up. The latter, which corresponds to the dynamism of the context, makes the plan adaptive and constantly updated (both in terms of geographical and operational contents).

In summary, all these characters of the urban strategic plan allow to identify the areas in which the city, on the basis of its identity, vocation and resources can (and should) try to excel autonomously, those in which, in order to be successful, must weave collaborative relationships with other regions (and on which it would be appropriate to invest) and those where it does not have or can acquire the conditions to play a significant role (and which it would be reasonable to give up).

As for the role of the actors involved in the planning process, the conditions of openness, partnership and leadership are fundamental (Pugliese & Spaziante, 2003; Donna, 2010). The drafting and subsequent implementation of the urban strategic plan requires an open and transparent logic, which is at times relational and communicative, engaging and participatory, in order to promote the fruitful interaction between the plurality of key public and private subjects and prevent both the self-referential attitude of the former and the opportunism, indifference or exclusion of the latter. In this way, it is possible to strengthen democratic participation as well as the accountability of local governments, to balance all powers involved, to positively deal with conflicts of interest, and to promote mutual trust and a sense of belonging of the different actors, encouraging proactive and collaborative approaches. Growing importance is also attributed to the development

of partnership relationships, based on strategic alliances between public and private actors, which are the result of voluntary agreements governed clear rules and by negotiation skills that allow a clear distribution of responsibilities, tasks, risks and benefits among stakeholders. Essential, in any case, is the exercise of the function of leadership by local governments, which presupposes their authority and their legitimacy and results in the construction of truly shared and consensual scenarios.

Under these conditions, the plan can be a real tool for public governance and strategic management, able to dynamically integrate the needs for economic development, social and environmental protection with the management tools that are necessary to achieve the shared selected and priority goals, on which it is possible to attract interests, generate resources and promote the assumption of responsibilities.

This can be, therefore, a potentially high-impact instrument, both ambitious and challenging, of significant innovative value, that requires the acquisition, development and dissemination of appropriate knowledge and skills, primarily within the promoting local authority, and that can follow different methodological approaches according to the specificities of the context (Gibelli & Curti, 1996; Capello & Nijkamp, 2004).

Nevertheless, we must counter the risk, often found in practice, of a purely formal and rhetorical use of the term "urban strategic plan", which is not reflected in the actual processes of local government and which would make us miss the opportunity of producing real change. In essence, we must avoid that the plan appears to be indifferent from the way in which decisions are taken as well as to their content (Antoniacomi, 2006; Codecasa, 2009).

In other words, it is important to avoid, first, the risk of preparing a weak version of the strategic plan, based on a mostly self-referential vision of the scenario and the socio-economic dynamics involved. This version would be neither open nor participatory, or, on the contrary, it would tend to be inclusive of all the possible issues and, therefore, neither clear nor selective. By excluding the ideas and contributions of some of the possible partners and failing to achieve the necessary critical mass, this weak version of the plan would end up being considered unrealistic (for lack of resources) or too generic (for redundancy of objectives), and therefore would not be convincing or compelling, unable to arouse interest, generate consensus, gather energies, determine effort and produce results.

A second risk to avoid is to consider the urban strategic plan as a practice in itself, taken out of context, without any real impact on behavior both within the local authority and by other public and private actors. Within the institution the risk is to be unable to counter the inert rigidity of the organizational structure and its compartmentalization. This would also be due to the failed link between the strategic plan and other tools of managerial and economic-financial planning. In the relationship with other stakeholders, the risk is of not being able to inspire confidence and willingness to cooperate. Sometimes this is the consequence of organizational confusion, which undermines the credibility of the institution. At other times it is the result of the perception of a hegemonic attitude on the part of the local authority. In all cases it is the result of poor communication and negotiation skills, which do not adequately support the reputation of the institution before its stakeholders.

In addition, it is important to counter the risk of the lessening over time of the motivation behind the planning effort. This could be due to the difference between the time horizon of the urban strategic plan and the length of the administrative terms of office, but also to the difficulty of keeping high the involvement of other key actors, both public and private. In essence, this difficulty refers to the lack of awareness by local governing bodies and other interested parties of the always evolving and network-type nature of the strategic planning

process. On the one hand, this process develops perhaps cyclically over successive phases of diagnosis, planning, implementation, and evaluation, though never seeing an end due to the constant and dynamic re-designing of the desired future scenario. On the other hand, this process is carried out in a fluid and often unconventional way, beyond the traditional perimeters and administrative proceedings and following an imperfect path, away from an abstract and absolute rationality and in the constant and dynamic search and (re-)composition of collaborative and synergistic relationship.

As a consequence, making the strategic planning process effective is neither simple nor obvious. It is indeed rather ambitious and challenging, though potentially rewarding for the positive effects that may arise in terms of innovation and regional development.

The Intellectual Capital in the Creation of Local Public Value

The increasing complexity and dynamism of the internal and external management of local authorities make it increasingly crucial for them to draw on appropriate knowledge resources. As it is the case for any private or public company, these resources are at the origin and at the same time the results of its operation, taking shape as the dynamic set of potential capabilities available to the institution to achieve its distinctive function. From the use of these resources, the local authority derives the conditions that define its identity, its levels of effectiveness, efficiency and cost effectiveness, its processes of public value creation and its paths of development (Coda, 1991; Ferrando, 1998).

The intellectual capital of a local authority is constituted of the multi-faceted and evolving system of knowledge resources. The human, organization and relational components contribute to this capital in an integrated manner (Brooking, 1996; Edvinsson & Malone, 1997; Roos et al., 1997; Stewart, 1997; Sveiby, 1997). Human capital is defined as the set of individual skills held by the members of the organization, whether they are components of the governing bodies, the management, the administrative and technical structure or external collaborators. These skills are expressed in terms of both experience and entrepreneurial, managerial, professional and operational knowledge. Organizational capital is defined as the implicit and explicit knowledge contained in routines, manuals, procedures and operational mechanisms, from which corporate culture springs and which defines the way of being and operating of the entity. Relational capital is defined as the knowledge that gets created in the relationships that develop between the institution and the wide range of its stakeholders, from which it derives its reputation and credibility, legitimacy and consensus—in other words, the image of the institution in its socio-economic environment.

The particular characteristics of local authorities, their public nature, their political dimension, their distinctive functions, their diverse activities and the multiple roles they play in the socio-economic context constitute the main variables that contribute to outline its intellectual capital, to define its constituent elements and the relationships that get established between them, as well as the manner of their acquisition, training and management.

These components have a common denominator in their beings based on knowledge, which is capable of multiple modes of formation and evolution (Nonaka & Takeuchi, 1995). They make it difficult to acquire knowledge, both in the case of its internal creation and in the case of external acquisition, and also make it very random in terms of possible rapid perishability and uncertainty of return. Nevertheless, the cognitive content of the intellectual capital makes it highly specific and such that would result in a significantly distinct behavior of the local authority and its ability to intervene, giving it complementary characters of competence and

confidence (Vicari, 1991; Buttignon, 1996; Lipparini, 1998).

In particular, this competence, be it individual or organizational, is expressed in the institution's ability to identify, confront and resolve the internal and external problems that are involved in the creation of public value in a cost-effective way. In turn, confidence, whether expressed inside or coming from outside, helps to improve the institution's ability to interact with its stakeholders. Competence and confidence and the resources from which they affect each other trigger potential virtuous circles (or, conversely, vicious). High (low) levels of competence, matched by appropriate (inappropriate) responses to internal and external management problems, feed (dissipate) confidence in the institution on the part of those who interact with it, since they see their expectations of successfully fulfilling their needs met (unmet). Moreover, high (low) levels of confidence, either internal or external, which correspond to stable (unstable) interrelations between the institution and its various stakeholders, facilitate (hinder) the formation, accumulation and activation of competence in the various management processes, making it easier (more difficult) to establish and maintain relationships with accessible lenders, reliable suppliers, qualified partners and employees, loyal taxpayers, satisfied users, and responsible citizens.

However, as already noted, socio-economic development only partly depends on the work done by the local authority. Equally important are the roles played and the contributions made by the other players in the system. Moreover, as in the case of local authorities, the latter intellectual capital is a decisive factor in their success and in their contribution to the creation of local public value. After all, given the inter-relationships that bind together the various socio-economic actors, even their respective knowledge resources are variously related to each other, making up, at the systemic level, the intellectual capital of the given community.

In the knowledge economy (Sakaiya, 1991; Drucker, 1994; Longworth, 1999), intellectual capital is an important variable for the creation of value not only for individuals and businesses, both private and public, but also for local, regional and national communities (Bounfour & Edvinsson, 2005). The creation of wealth, socio-economic growth, the level of well-being and the quality of life of the community all depend on it.

Therefore, local authorities can usefully, directly and indirectly intervene to promote the generation, dissemination and development of the intellectual capital of their own communities. For instance, it may prove useful to carry out initiatives to promote higher education and vocational training, support research centers and scientific projects, build or enhance infrastructure, and promote technological innovation. No less important are policy initiatives aimed at improving the overall quality, both intrinsic and perceived, of the local environment and its social life, which can in turn attract new production facilities and the inflow of knowledge workers. These policy initiatives are often cross-sectorial, concerning urban planning, public works, safety as well as requiring facilities and services in the field of culture, sports, tourism and recreation. These policies can be included into the broader policies of territorial marketing, which aims at promoting the regional area and increasing its ability to maintain and augment its resources as well as attracting new ones, activating a virtuous circle of satisfaction-attraction-value creation (Valdani & Ancarani, 2000).

Particularly relevant in this context is the relationship that can emerge between the institution's intellectual capital and the intellectual capital of the community. On the one hand, the resources of competence and confidence of the local community qualify, with different sign and intensity according to their degree of appropriateness, the results of the policies and actions directly and indirectly aimed at the development of intellectual capital in the community. On the other hand, the latter, interacting with the intellectual capital of the entity (in the front-line activities, in the events and projects, in the inter-institutional relationships, and in the

processes of communication), can variously influence it, encourage and support its development or on the contrary detract from it. A circular relationship, therefore, gets created. This, if positively implemented, can be potentially viable and fertile.

In other words, the development of the intellectual capital is an essential condition for the local authority in order to best serve its function of creating local public value, which has among its determinants and consequences the development of the intellectual capital of the community. Therefore, since the development of its own intellectual capital and that of its community are crucial inputs for the local authority, both should be part of its decision-making and policy-making processes and should be included in its information, planning, control and communication systems.

These considerations, which are valid in general and for any contemporary city, are central to what is called "knowledge city" (the emblematic case is Barcelona) and any city that aspires to become one (Amato et al., 2006; Carrillo, 2006).

In the knowledge era, in fact, we expect that any successful city can be able to provide (Ergazakis et al., 2004): a high quality of life; the availability of effective, efficient and innovative services and infrastructure, especially in the areas of education and culture, research and technological development, mobility and communication; a business structure that is supported by a culture that is both cooperative and competitive; a strong and vibrant economy; a structured network of relationships that can attract resources and the exchange of products with the outside world; a social environment that is open, supportive and inclusive.

In addition, other elements that are essential to a knowledge city are: the allocation of facilities, networks and tangible and intangible assets for the production of goods and services based on knowledge (in the broadest sense of the word and, thus, potentially in its scientific, technological, cultural, and artistic manifestation); the development of conditions able to promote talent, creativity, innovation and enterprise; the availability of technologies, instruments and services for the systematic, effective and efficient dissemination of knowledge; the presence of actual and virtual places that can facilitate interpersonal relations, the exchange of information and the sharing of experiences; the ability to generate, attract and retain citizens who are not only highly qualified from a professional point of view but also engaged with the political-institutional life and environmentally-conscious. In essence, a knowledge city is purposely designed to encourage and nurture the collective knowledge, that is, the intellectual capital of the community, seen as a determinant factor for the sustainable creation of local public value (Edvinsson, 2006).

It needs to be stressed, however, that there is no single model of knowledge city, but that there are as many variations as there are models of knowledge, with all their possible nuances and combinations (Hall, 1998; Hospers, 2003). Therefore there are, at least ideally, the science city, the culture city, and the city of technological innovation, to name just a few recurring instances. In each of these cities the qualifying element emphasizes one particular aspect, which is not necessarily exclusive but is considered strong enough to identify the specific urban context or its distinctive mark. It needs to be pointed out that even within the same model, the differences are often significant, due to the highly distinctive way in which knowledge is acquired, developed, stored, combined, used and valued, from which different profiles and evolutionary pathways result (just think of the three European Capitals of Culture in 2010: Essen in Germany, Pécs in Hungary and Istanbul in Turkey).

Although in its variety, the knowledge city, to be considered such and become successful, must prove to be genuinely creative. This means that it must develop an original model of socio-economic development

through a clear strategic direction, a model that makes the most of its identity, its vocation and its specificity, avoid improvised or unrealistic approaches as well as give in to emulative practices which are indeed fairly common.

Obviously, some contextual conditions are essential, notably the concentration, variety and variability of the reference community (Camagni, 1993; Landry, 2000). Concentration, which is defined as the presence of a significant number of people in a given geographical space, is an essential factor from both a qualitative and a quantitative perspective, since it ensures the necessary volume but especially the high intensity and frequency of interpersonal and inter-organizational relationships within which knowledge can grow and spread.

Variety, in the broadest sense of the term, refers both to the community, with the differences among people, their knowledge, activities and needs, and to the territory, with the combination of different uses of the urban area (residential, touristic, administrative, manufacturing, commercial, recreational, and so on). Variety determines the wide array of opportunities for interaction and promotes the development of creativity, innovation and enterprise.

Variability, in the double meaning of instability and dynamism, is also very significant, since it is from situations of uncertainty and struggle that important innovations might emerge (especially when the fear of a crisis overcomes the aversion to change). Likewise, it is from the opening and consequent evolution of the urban environment that the cognitive capital can be increased and new opportunities for development can be materialized.

Nevertheless, the local authority through its policies can play a key role in supporting networks of knowledge and innovation (Cappellin, 2007). Specifically, it can help reduce their production and transaction costs, promote the development of specific skills and disseminate a climate of trust among the socio-economic actors of the reference area—for instance, by improving their business skills and promoting their learning, relational and cooperative processes.

The local authority may, in fact, be an important vector of systemic interactions and sometimes of strategic alliances among businesses, especially small ones, and between them and financial intermediaries, training structures and research centers. It can encourage the sharing and pursuit of strategic projects, reduce information asymmetries, limit the risks involved in innovation processes, facilitate the linking and strengthening of value chains, and in this way, socio-economic development. The latter, in order to be robust and sustainable, needs to be pervasive, emphasizing inclusion and reducing the gaps between differently-gifted individuals, for the sake of the well-being and quality of life of the whole community (on which problematic situations weigh more than positions of privilege).

However, in order to accrue the benefits deriving from the creation of public value, a knowledge city not only must (try to) be such, but also must be able to communicate its objectives and be perceived as a knowledge city. The construction of an image that is at the same time recognizable and attractive, credible and distinctive plays a decisive role in determining the success of a knowledge city.

The Intellectual Capital in Urban Strategic Planning

In view of the contribution that strategic planning gives to the creation of local public value and of the key role in it played by intellectual capital, it may be interesting to verify if and how the latter is included in urban strategic plans, and if consideration is given to its various meanings, components, operating modalities, and its contribution to the functionality and the socio-economic development of the local authority. Specifically, we

intend to analyze whether or not intellectual capital is taken into account in the urban strategic plans of the Italian regional capitals, as reflected in the documents published on their relative institutional websites.

Focusing on study on the regional capitals allows to analyze a relatively limited but significant sample of institutions that, although characterized by some common features, differ in several aspects, ranging from the size (from about 35,000 inhabitants of Aosta to the more than 2.7 million people of Rome), geographical characteristics and territorial and socio-economic aspects, covering substantially all of the significant areas of the country. They constitute, therefore, a sufficiently representative sample of the variety that characterizes the system of local authorities and especially the major Italian cities.

The documents considered, despite of the variety of denominations and methodological approaches, include all urban strategic planning tools published on the web as of March 31, 2011. The reference to the documents available online provides useful information on the degree of sensitivity of the specific local administration to the wider dissemination—in terms of accountability—of the information included in the plans, and, through it, it aims to support its relational capital.

Table 1

Urban Strategic Plans of Italian Regional Capitals: Overall Framework

Municipality	Document	Year	Website
Aosta	Future of Aosta: Strategic Plan of Aosta and of La Plaine	2010	www.comune.aosta.it
Turin	1. City Strategic Plan—Turin International	2000	www.comune.torino.it
	2. Strategic Plan of the Metropolitan Area	2006	www.torino-internazionale.org
Genoa	1. Plan of the City of Genoa	2002	www.comune.genova.it
	2. The City Changes (UrbanLab)	2009	www.urbancenter.comune.genova.it
Milan	Government Plan of the Territory	2011	www.comune.milano.it
Trento	1. Strategic Plan 2010	2003	www.comune.trento.it
	2. Strategic Agenda "Trento 2020"	2007	www.laboratoriourbano.tn.it
Bolzano	Ideas for 2015: Thinking the City	2004	www.comune.bolzano.it
Venice	Venice Metropolitan Area	2004	www.comune.venezia.it
Bologna	Municipal Structural Plan	2007	www.comune.bologna.it
Florence	1. Strategic Plan Florence 2010	2002	www.comune.fi.it; www.urbact.eu
	2. Strategic Plan: There is More than One Florence	2009	www.firenzefutura.org
Ancona	A Plan for Ancona: The Changing City	2009	www.comune.ancona.it
Perugia	Perugia—Europe From 2003 to 2013	2004	www.comune.perugia.it
Rome	Strategic Plan for the Development of Rome Italian Capital	2009	www.comune.roma.it; www.progettomillennium.com
L'Aquila	L'Aquila 2020 (suspended after the earthquake of April 6, 2009)	2008	no
Campobasso	Territorial Strategic Plan	2008	www.comune.campobasso.it; www.pianostrategicocampobasso.it
Bari	BA2015—Metropolitan Area of Bari (MTB)	2008	www.comune.bari.it; www.ba2015.org
Naples	Strategic Plan	2006	www.comune.napoli.it
Potenza	Strategic Project of Potenza's Hinterland	2005	no
Catanzaro	Strategic Plan	2011	no
Palermo	Palermo, Capital of the Euro-Mediterranean Area	2010	www.comune.palermo.it
Cagliari	Strategic Plan	2008	www.comune.cagliari.it; www.pianostrategicocagliari.it

In general, there is a significant commitment to urban strategic planning: 20 out of 21 municipalities (95%, with the exception of Trieste) have started a strategic process (although sometimes with some difficulties, as in the case of L'Aquila, where, following the severe earthquake that struck the city, the path has inevitably

suffered a setback). There is also a high level of disclosure, since 17 municipalities out of 20 (85%, with the sole exceptions of L'Aquila, Potenza and Catanzaro) publish online their urban strategic plans (see Table 1).

No less significant is the reading of the data at a demographic level, according to the classes identified by the Ministry of the Interior, and with reference to the different geographical areas identified by Istat—the Italian Institute of Statistics (see Table 2).

Table 2

Urban Strategic Plans of Italian Regional Capitals: Data by Demographic Classes and Geographical Areas

	No. of municipalities	No. (%) of total population	No. (%) of strategic plans	
			Produced	Published
Total	21	9,732,740 (100)	20 (95)	17 (81)
Demographic classes (Interior Ministry)				
Up to 100,000 inhabitants	5	319,897 (3)	5 (100)	2 (40)
From 100,000 to 250,000 inhabitants	6	853,516 (9)	5 (83)	5 (83)
From 250,000 to 500,000 inhabitants	4	1,342,822 (14)	4 (100)	4 (100)
From 500,000 to 1,000,000 inhabitants	4	3,130,918 (32)	4 (100)	4 (100)
Over 1,000,000 inhabitants	2	4,085,587 (42)	2 (100)	2 (100)
Geographical areas (Istat)				
Northwest	4	2,874,628 (30)	4 (100)	4 (100)
Northeast	5	1,076,927 (11)	4 (80)	4 (80)
Center	4	3,403,925 (35)	4 (100)	4 (100)
South	6	1,564,897 (16)	6 (100)	3 (50)
Islands	2	812,363 (8)	2 (100)	2 (100)

From a demographical point of view, the classes of municipalities with the highest level of strategic elaboration and dissemination are those above 250,000 inhabitants, where all the institutions establish and publish their strategic planning documents on the web. The next smaller size class (between 100,000 and 250,000 inhabitants) is still characterized by a high degree of strategic disclosure, making all the plans they formulated available online (five out of six bodies, representing 83% of total local authorities). Relatively smaller, however, is the commitment of the regional capitals of smaller size (up to 100,000 inhabitants), in which only 40% of the plans are published.

Geographically, the regions in the northwest and center of the country plus the insular areas are those that, overall, are characterized by a larger strategic development and transparency, with the formulation and online publication of strategic plans by all regional capitals. The Northeast area still displays a substantial level of strategic planning and disclosure (all four strategic plans formulated by the five municipalities included in the analysis are published online, representing 80% of the total administrations). The southern area, even in the presence of a high level of strategic planning commitment (all regional capitals have begun the process of strategic planning, though this has been sometimes suspended, as already noted), is characterized by a lower level of disclosure (about 50%).

In addition to the number of strategic plans that were produced and disclosed, it is interesting to analyze some other qualifying aspects. First of all, even if all the documents are characterized by a strategic breath and a medium to long-term perspective (usually 10 years long), three out of 17 plans (representing 18% of the total) focus exclusively on the city planning aspects of the plan (it's the case of Ancona, Bologna and Milan), even if they are the result of participative decision-making processes.

It is also important to point out that, although in most cases the process of urban strategic planning and implementation is directly promoted by the regional capital, there are cases, like those of Turin and Florence, where the process is initiated, implemented and disseminated by a separate organization (namely "Turin International" and "Florence Future") gathering both public and private actors and without any management power. In these cases, the plan may contain highly sophisticated analyses and proposals, be perceived as the privileged site for the meeting and engagement of all key-players and for the establishment of an effective communication strategy, but hardly as an authentic instrument of local government.

One further consideration to make is that most of the urban strategic plans are fairly recent (nine out of 17 plans, representing 53% of the total, are less than five years old). It would therefore be premature to assess the impact they had on their socio-economic environment. Among the older experiences, there are a few that are fairly significant, especially those of Turin, Trento, Florence and Genoa, which have already moved to the second generation of urban strategic plans. In the first three of these cases, the second plan stems from a critical analysis of the structure, content, and status of implementation and impact of the first plan. In the case of Genoa, however, the two documents are not sequential and rather highlight a discontinuity of both strategic and administrative nature.

Furthermore, all the plans that are analyzed include frequent references to:

(1) Change (for example: "Aosta future"; the plan of Bolzano "Ideas 2015: Thinking the City"; the second plan of Genoa "The City Changes"; and "A Plan for Ancona: The Changing City");

(2) The largest metropolitan area (as in "BA2015-Metropolitan Area of Bari"; in "Venice Metropolitan City"; in the "2nd Strategic Plan of the Metropolitan Area" of Turin; in the "Territorial Strategic Plan of Campobasso and the Urban Network of the Central Molise Region"; and in the "Strategic Plan of Aosta and of La Plaine");

(3) International openness (emblematic here is the first "Strategic Plan of the City-Turin International"; and, among others, "Perugia—Europe From 2003 to 2013" and "Palermo Capital of the Euro-Mediterranean Area");

(4) The uniqueness of the specific urban context (for example, the "Strategic Plan for the Development of Rome Italian Capital").

Finally, for what concerns the focus of this article, there are frequent references to the model of the knowledge city or its characteristic features (mentioned in 15 out of 17 plans, representing 88% of the total plans), which are adapted to the specificity and aspirations of the particular socio-economic area. For instance, there are recurrent references, sometimes exclusive but more often complementary, to the city of culture and innovation (for instance, "Aosta Heritage City"; Genoa "A City of Knowledge"; Milan "The Attractive City"; Trento "The City of Art and Culture" and "The City of Knowledge"; Venice "City of Culture" and "City of Higher Education, Research and Innovation"; Florence "Cultural Production"; "Rome City of Culture and Entertainment"; "Surprising Campobasso"; Bari "Metropolis in a Bit").

Within this framework and considering the overall high levels of strategic planning and disclosure recorded by the generality of Italian regional capitals, as classified in demographic and geographical classes, we can verify what and how is reported about the intellectual capital of the institution and the community.

To begin with, it seems interesting to observe that in almost all of the 17 urban strategic plans that are available online there is some degree of reference to the intellectual capital. Somewhat predictable, the only two exceptions (which represent 12% of the total) are identified among the documents that mostly focus on city

planning (see Table 3).

Table 3

Intellectual Capital in the Urban Strategic Plans of the Italian Regional Capitals

		No. (%) of documents available online	
		Of the institution	Of the community
Total	Overall situation	17 (100)	17 (100)
	of which: without significant content	12 (70)	2 (12)
	with (only) descriptive parts	2 (12)	4 (24)
	with (also) quantitative specifications	3 (18)	11 (64)
Demographic distribution	Until 100,000 inhabitants	2 (100)	2 (100)
	of which: without significant content	2 (100)	1 (50)
	with (only) descriptive parts	-	-
	with (also) quantitative specifications	-	1 (50)
	From 100,000 to 250,000 inhabitants	5 (100)	5 (100)
	of which: without significant content	2 (40)	1 (20)
	with (only) descriptive parts	1 (20)	1 (20)
	with (also) quantitative specifications	2 (40)	3 (60)
	From 250,000 to 500,000 inhabitants	4 (100)	4 (100)
	of which: without significant content	3 (75)	-
	with (only) descriptive parts	1 (25)	2 (50)
	with (also) quantitative specifications	-	2 (50)
	From 500,000 to 1,000,000 inhabitants	4 (100)	4 (100)
	of which: without significant content	3 (75)	-
	with (only) descriptive parts	-	-
	with (also) quantitative specifications	1 (25)	4 (100)
	Over 1,000,000 inhabitants	2 (100)	2 (100)
	of which: without significant content	2 (100)	-
	with (only) descriptive parts	-	1 (50)
	with (also) quantitative specifications	-	1 (50)
Geographical distribution	Northwest	4 (100)	4 (100)
	of which: without significant content	3 (75)	1 (25)
	with (only) descriptive parts	-	1 (25)
	with (also) quantitative specifications	1 (25)	2 (50)
	Northeast	4 (100)	4 (100)
	of which: without significant content	1 (25)	-
	with (only) descriptive parts	2 (50)	3 (75)
	with (also) quantitative specifications	1 (25)	1 (25)
	Centre	4 (100)	4 (100)
	of which: without significant content	4 (100)	1 (25)
	with (only) descriptive parts	-	-
	with (also) quantitative specifications	-	3 (75)
	South	3 (100)	3 (100)
	of which: without significant content	3 (100)	-
	with (only) descriptive parts	-	-
	with (also) quantitative specifications	-	3 (100)

(to be continued)

Islands	2 (100)	2 (100)
of which: without significant content	1 (50)	-
with (only) descriptive parts	-	-
with (also) quantitative specifications	1 (50)	2 (100)

At this level of analysis, it's then significant that all 15 documents containing information on intellectual capital talk of the intellectual capital of the community, considered exclusively in 10 cases and combined with the intellectual capital of the institution in five cases (33% of the cases). This evidence is not particularly surprising, given the main socio-economic finalization of urban strategic plans. Nevertheless, in view of the interdependencies between the intellectual capital of the institution and that of the community and their co-evolutionary nature, an explicitly integrated view could be not only more appropriate but also more credible, especially in support of initiatives of administrative innovation.

It is also important to analyze which type of content is used to describe intellectual capital. References to intellectual capital are found in the context and scenario analyses, in the identification of the strategic areas or themes, in the discussion of general and specific goals achieved and in the formulation of programs and projects. All the 15 plans include significant references to the intellectual capital of the community and the five also consider the intellectual capital of the institution there are descriptive elements. In most cases (11 out of 15 and three out of five respectively), however, there are also quantitative analyses, such as budgets of assigned financial resources, time references, and, although more rarely, evaluation indicators (but mainly without target levels, which appear in only two cases). Obviously, this is a matter which concerns not only the intellectual capital, but also the generality of the contents of urban strategic plans and is affected by the methodology applied.

For what concerns the different demographic classes, there is an increasing attention to the intellectual capital, especially that of the community, the bigger size of the city. In fact, while some regional capitals up to 250,000 inhabitants neglect this factor (one out of two up to 100,000 inhabitants and one out of five between 100,000 and 250,000 inhabitants), all the entities above this size deepen this issue, sometimes only at a descriptive level, more often also in quantitative terms. Partly different is the consideration of the intellectual capital of the institution, which receives a bit of attention in the class size between 100,000 and 250,000 inhabitants (three out of five administrations are explicit about it) and a positive but relatively less important attention (corresponding to one institution out of four), in both the higher size classes (up to 1,000,000 inhabitants).

The geographical aggregation of data shows, in turn, that the attention paid to intellectual capital is substantial and fairly well distributed across all regional plans—it never falls below 75% of the total plans. The areas that mostly stand out are those in the Northeast, the South and the Islands, in which all the strategic plans published by the regional capitals devote specific sections to the intellectual capital of the community. Moreover, the northeastern and insular capitals are those that also pay greater attention to the intellectual capital of the institution (in three out of four cases and one out of two cases, respectively).

To sum up, data show us that most regional capitals (considered individually and by demographical and geographical classes) display a substantial and widespread strategic sensitivity to the issue of intellectual capital, especially that of the community.

By deepening the analysis at the qualitative level, it is possible to analyze in greater detail the contents devoted to the intellectual capital, the meaning assigned to it and which of its aspects are actually considered.

With regards to the intellectual capital of the institution, which is considered in a few of the urban strategic plans (five out of 17), its role as a critical variable determining the effectiveness and the efficiency of the administrative action is confirmed. Yet detailed references to its constituent elements are virtually absent, being the attention focused almost exclusively on the human capital (interesting to this regard are the policies and actions developed by the respective municipality in the first strategic plan of Genoa and in that of Cagliari).

More significant is the reference to the intellectual capital of the community, present in 15 of the 17 plans examined, where we can find three slightly different settings:

(1) The first one identifies it as the main if not the sole determinant of local public value creation, toward which the strategic commitment of the institution must be primarily directed (this is the case of five out of 15 entities, representing 33% of all analyzed institutions). So, for example, the "Strategic Plan of the Metropolitan Area" of Turin (2006, p. 26) "defines a new development model in which the central element for the creation of value is knowledge… It is in this perspective that the 12 points of intervention are formulated". In turn, the "Strategic Agenda 2020" of Trento (chapter "Knowledge Economy", 2007, p. 1) makes it clear that "a shift towards a knowledge economy is probably 'the' theme of the strategic plan, a theme to which it is necessary to devote new focused policy initiatives";

(2) The second setting considers the intellectual capital as one of the determinants of socio-economic development, to which a significant part of the strategic action should be directed (in seven of the 15 plans, 47% of the total). For example,

> The overall objective pursued by the strategic plan of Venice is to construct… a city characterized by the high quality of life of its inhabitants-in its relational, business and cultural aspects-and by the high quality of its physical structure and environment. ("Venice Metropolitan Area—Quality, Labor, Cultures", 2004, p. 15)

And again, in the "Strategic Plan for the Development of Rome Italian Capital" (2009, p. 11), four "strategic objectives, which represent four synthetic images of the future of the city (City of environmental sustainability; City of polycentric solidarity; City in the global competition; City of culture and entertainment)";

(3) The third setting defines intellectual capital as the common thread that unifies and connects the various strategies pursued by local authorities (three out of 15 entities, 20% of the total). For instance,

> The vision of Naples as the "fire" of the Mediterranean, the source of creative energies and skills, and the central place of migration flows to the East is not only the image that provides a coherent framework for the city's projects, but also and above the construct and the impulse that generates common goods and social capital, starting from the identity of the city. ("Strategic Plan" of Naples, 2006, p. 11)

Similarly, in the strategic plan of Bolzano City on a human scale, the management of knowledge resources cross the five vocations defined and oriented to "develop the economy; facilitate the settlement of compatible life; position and communicate; organize, and govern the city" ("Ideas for 2015: Thinking the City", 2004, p. 2).

Although defined in different ways, the intellectual capital of the community is described in almost all the urban strategic plans for both its management methods (in 100% of cases) and its impacts on the expected creation of local public value (in 93% of cases). With regards to its management methods, the plans consider the actions of both the local authority and of the other social actors that are useful to acquire, train, promote, defend and advance the knowledge resources of the community. With regards to its impacts on the creation of

public value, the plans highlight its benefits in terms of economic development, job creation, social cohesion, environmental quality, and urban wellbeing (in terms of the contributions offered by the intellectual capital of the community, particularly interesting is the strategy map, including the overall objectives, specific objectives and project guide, of the section "Knowledge, Innovation and Development" of the strategic plan of Cagliari. Equally significant are the documents of presentation of the three flag-projects that comprise the strategic line "Strengthening the cultural areas of excellence: historic and artistic heritage, major events and University" inserted in the plan "Perugia—Europe From 2003 to 2013").

The explicit and comprehensive identification of the constitutive elements of the intellectual capital of the community is less common and in-depth analyzed. Where these elements are considered (as it is the case in the urban strategic plans of Turin, Trento, Florence, Bari and Cagliari), the focus is on human capital (particularly detailed in the "second strategic plan of the metropolitan area" of Turin) and structural capital, both in its organizational and relational component (to this regard, it is significant the project of innovation and development entitled "Florence Knowledge: The Network of Knowledge and Know-how" contained in the second strategic plan of Florence).

A final aspect concerns the use of performance indicators (also) related to the intellectual capital, through which it is possible to measure and monitor the resources invested in it, the planned activities and the expected results. As already mentioned, the most common indicators, inserted in the urban strategic plans that were analyzed, were those of a timeline nature (related to compliance with timetables) and financial nature (related to resources, especially public, allocated to programs and projects). It is quite rare instead the use of output, outcome and impact indicators, which however would be necessary to make clear which goals were achieved and to verify which results were obtained (an exception is represented by the urban strategic plans of Bari, Cagliari and Palermo, which are particularly structured in this respect).

Some Critical and Perspective Considerations

The utility of urban strategic planning for the creation of local public value and the crucial contribution that intellectual capital offers to this objective are clearly evident from the analysis of the literature and from the empirical data collected on this subject. However, some critical and perspective considerations are warranted.

As suggested by the best public management scholarship and as positively experienced by the most innovative administrations, the intellectual capital of the local authority is a crucial variable, which contributes to both the cost management of the institution and the creation of local public value. The latter, however, also depends on the contribution of the other actors of the socio-economic system, which finds, in turn, a decisive factor in the intellectual capital of the community.

Since both the intellectual capital of the institution and that of its community are critical sources of management performance and local public value, they should be the subject of specific attention in the cognitive schema, the decision-making models, the operating mechanisms and the relational processes of the local authority—in other words, in its system of governance.

The guidance and monitoring of the intellectual capital of the institution and its community require the knowledge and analysis of their constituent elements, of the relationships between them, of their ways of acquisition, formation and evolution, of the causal links that connect them to management performances and socio-economic development. In essence, appropriate reporting systems are required, which are able to preside

both qualitatively and quantitatively over the immaterial aspects of the intellectual capital that permeates the institution and its community.

Nevertheless, most of the urban strategic plans that are herein analyzed give a partial representation of the intellectual capital, containing sometimes wide and detailed descriptions, but often lacking, if not absent, quantitative determinations. It is quite exceptional, in fact, the use of symptomatic indicators that can express the distinctive features of particular knowledge resources, their composition, their dynamic and their contribution to the management of the institution and the socio-economic development of the community.

This is a significant weakness, since the appropriate management of the intellectual capital (as well as of any other critical success factor) requires the most comprehensive and transparent consideration, achieved through a composite representation, at once qualitative and quantitative, monetary and operational, which can make explicit in a comprehensible and demonstrable manner its constitutive elements, its management processes, its contribution to the pursued strategic paths and to the creation of local public value.

To this regard, it is worthy to emphasize the close and inseparable connection between the measurement and the evaluation of these phenomena. Without the measurement of expected results, especially in terms of impact, it is not possible to assess the ex-ante validity of particular choices. Similarly, without the measurement of performance, it is not possible to assess the ex-post effectiveness of the actions undertaken. This relationship, at any time but especially ex-ante (where, as we have seen, it is mostly missing), is particularly relevant in the context of urban strategic planning, given the lack of revocability of the decisions taken, which does not suggest or, more properly, make it too expensive and risky to proceed by trial and error.

Furthermore, despite of the real complexity of the issue, and even assuming complexity as a condition and a value, there are several potential reference models, such as the Balanced Scorecard (Kaplan & Norton, 1996), the Intangible Assets Monitor (Sveiby, 1997), the Business Navigator (Edvinsson & Malone, 1997), the Intellectual Capital Index (Roos et al., 1997), the National Intellectual Capital Index (Bontis, 2002), Intellectual Capital Dynamic Value (Bounfour, 2003), and the Intellectual Cities Capital Benchmarking System (Viedma, 2004). These models have significant elements in common, notably the strategic importance of intellectual capital, its specificity to a particular context, its internal and external accountability, and significant differences—i.e., the purposes and possible applications of the model, the structure of the reports, the classes of performance indicators, the phases of implementation—and therefore they do not constitute so far a converging and consolidated framework (Zambon, 2003), suggesting the opportunity for further research on this subject. Yet the above-mentioned models offer interesting solutions, which can be of inspiration to local authorities.

At the systemic level, to their awareness, the development of the necessary skills and the dissemination of best practices in managing intellectual capital, pilot projects to be carried out at both the regional and national levels could prove very useful (these could be initiated by the Ministry for Public Administration and Innovation and the Ministry for Economic Development, respectively dealing with the intellectual capital of the institution and with that of the community).

At the level of the single institution, given an already significant attention paid to knowledge resources, it is possible to highlight some areas for rationalization. In particular, the methods and tools to report data on knowledge resources should be introduced where missing and refined where present. These methods should allow both the qualitative representation and the quantitative determination of the energies devoted to and the performance achieved (in terms of outputs, but above all outcomes) in the management of the intellectual

capital of the institution and the community. In addition, since knowledge resources are not only valuable by themselves, but also significant and useful for the overall functioning of the institution and the creation of local public value, the reporting system applied to them can be usefully integrated in the instrument of planning, monitoring and communication concerning the overall management of the institution and its global performance.

To this regard (and with reference not only to intellectual capital), a further weakness that was already pointed out in previous studies (Fontana, 2009) concerned the little consistency of the information contained in urban strategic plans with that contained in the budgets and other financial and managerial control tools. This incongruity, which is not surprising where the process of strategic planning is managed by outside agencies, also frequently occurs in the case of direct governance by the same local authority, typically involving several political sectors and management responsibility centers. The main causes of this phenomenon are: the potential divergence between individual objectives and needs for visibility, the traditional rigidity of the organizational structure, the difficulty of implementing an effective team game among both political and technical key-actors, the absence of a sufficiently authoritative, recognized and cohesive leadership, and the mostly rhetorical and formal use of the various instruments of governance.

This is a rather significant problem, because of a lack of connection between the management control instruments of the local authority and the urban strategic plan risks, on the one hand, to mitigate, if not frustrate, the actual impact of management goals, making them of a shorter and narrow-ranging perspective, and, on the other hand, to limit, if not undermine, the effective implementation of the more statutory purposes, thus impeding the translation of the strategy into action.

In order for the planning and control instruments to successfully contribute to support the governing and management processes of the institution, their convergence is necessary, and especially the integration of the strategic and operational dimensions and between them, and the economic and financial ones. These integration solutions are, in fact, essential to make meaningful, relevant and functional the overall system of governance of the local authority, avoiding the proliferation of a multitude of independent and distinct tools, perhaps singularly well-designed, but likely to compose a too crowded instrumental framework, which can be redundant and wasteful, inevitably rigid, costly and of little value, since it is essentially alien to the effective processes of governance and management.

With specific regard to urban strategic planning, there are many other weaknesses, concerning both methodological and substantive issues, which should be adequately addressed. For what concerns substantive issues, two are at least the perils that must be avoided: on the one hand, the excessive generality of the strategic objectives, typical of settings that tend to be all-inclusive of the possible items, and, on the other hand, the opaque definition of the contents of the plan, as a result of non-rational or non-transparent choices. For what concerns methodological issues, and especially the way in which decisions are made, the main risks and limits concern the only apparent openness of the planning process and the purely fictitious involvement of civil society. This corresponds to a path that is circumscribed to the narrow political and administrative boundaries (both spatial boundaries, the so-called "within the palace's walls", and temporal boundaries, bounded by the duration of elective office) or, no less seriously, to a privileged and non-transparent relationship among strong powers (including, in particular, real estate ones).

Another risk not to be underestimated is the lack of coherence, in terms of harmony and synchrony, as well as in terms of horizontal and vertical integration, between the strategic plan of a local authority and

those of contiguous territorial contexts (not only geographically close, but also more generally united by the same socio-economic problems) and also those of other levels of government (provincial, regional, national). This aspect is important, especially for the urban realities of smaller size, which are increasingly, and per se praiseworthy, testing solutions for strategic planning. If the need for an integrated approach is not taken into account, these initiatives might be characterized more for their audacity than for their probability of success.

In all such cases, the governance tools that have been adopted are often only formally "for governance". They are instead dominated by rhetoric, fashion or fiction, they are at times self-referential, shortsighted, emulative, unrealistic, bent to particular interests, and in any case unable to contribute to the creation of local public value. In other words, they tend to be irrelevant to the directions of change of the corresponding socio-economic system.

In order to be useful, however, urban strategic planning requires the prior definition of appropriate rules concerning its greater openness, the transparency of information and communication flows, the solutions for the involvement and participation of social actors, partnership arrangements and the exercise of leadership. These are essential rules to try to reduce and overcome—with the awareness of never succeeding completely—many areas of risk inherent in both the decision-making and implementation processes. These risks include actors not being open to dialogue and exchange, information asymmetries, imbalances of powers, divergence of interests, unstated priorities, lack of resources, inertial activities and unforeseen emergencies.

Nevertheless, urban strategic planning, if carried out according to the above-mentioned system of rules, allows giving answers to critical problems that are considered most appropriate by the vast majority of stakeholders—that is, it provides answers that are largely shared across all interested actors. In other words, it is necessary to build a clear, strong, distinctive and long-term vision and to formulate specifically selected yet at once flexible and adaptive goals and projects. The result will be an agenda for local government that is significant enough to make a difference, streamlined enough to be effectively implemented, and shared among relevant actors so as to mobilize interests, build consensus, attract resources and produce positive results.

It is the very production of positive results obtained through the implementation of strategies, the activation of processes of collective learning, the higher cohesion among social actors, better ownership of new policy initiatives, and the progressive realization of the ideal city—that demonstrates the effectiveness of the urban strategic plan, that is its ability to lead, and not only to describe, the creation of local public value. This is, after all, its main function, which allows the local authority to carry out its mission and assert its key-role in the socio-economic system.

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How Social Networks, Digital Media and Digital Marketing Can Be Applied to the Promotion of Goods and Services in Business Companies in Order to Increase Sales

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New technologies are highly important nowadays, not only in the complex world of business but also in the day-to-day life of modern societies. Major advances in communications have minimized the cost of making business transactions and also, the time required to do so. Accordingly, a model will be described that explains how new technologies affect different business-related aspects. In order to compare this model empirically, information has been gathered in the business context of Alicante, Spain, and a measuring tool has been developed and validated through 405 valid questionnaires. The statistical analysis was made using SPSS (Statistical Product and Service Solutions) and EQS (Structural Equation Modeling).

Keywords: Internet, information and communication technologies (ICTs), business

Internet has revolutionized the way in which human beings socialize nowadays, by breaking down the physical and geographical barriers and enabling communication in real time. Similarly, this great advance in communication has also become advantageous for the business world, since new technologies have improved and facilitated the ways in which we do business and contribute to consolidating a more global world and community.

Conceptual Framework and Hypotheses

Internet Marketing

The concept of "Internet" is frequently explained in the literature as "a type of information structure that has a global scope and comprises computer hardware and software that is characterized by being general and open in nature" (Peterson, Balasubramanian, & Bronnenberg, 1997, p. 330). The Internet is considered to be general in nature, since, from its outset, it has never been conceived for a specific type of activity and over time, it has attained its current cross-cutting status; it is open because it is accessible to anybody. For modern societies, the Internet represents an efficient method of access to information, communication and data exchange. And according to authors like Levy (1996), it was expected to become the backbone network of future societies.

Muela (2008) reported that the emergence of the Internet in communications media had meant significant

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changes in traditional systems and forms of communication that simultaneously brought together senders and receivers from all parts of the world. Tools like e-mail have made traditional mail systems obsolete because of the many advantages it has to offer, i.e., cost savings, greater volumes of information, speed, etc. The Internet has revolutionized the way in which we communicate and its use has benefited the immense majority of the production and leisure sectors throughout the world—the latter mainly due to the features that make it unique, i.e., (1) the ability to store large amounts of information in different virtual locations, all at a very low cost; (2) the possibility to search for, organize and disseminate information; (3) the fact that it is interactive and is able to supply information on demand; (4) the ability to provide perceptual experiences; (5) the ability to serve as a means for transactions or exchanges; (6) the ability to serve as a means for physical distribution of certain products, such as software; and (7) the very low cost of its adoption by clients and suppliers.

In recent years, the use of the Internet as a business tool has become obvious, since its main feature is that it can be both a medium and a market at the same time; in other words, it is a market, since it is a place where the supply-side and the demand-side can interact merely by using a computer, yet, at the same time, it is a medium because it carries out the functions of a company, e.g., marketing, sales and distributions (Farhoomand & Lovelock, 2001).

Definition of the Internet Marketing Concept

The fact that Internet marketing is constantly changing makes it difficult to conceptualize on the basis of existing studies. Nevertheless, it can be said that in order to reach a clear definition of this concept, we would firstly have to break it down into its different components. The Internet is a global system of computer networks that provides reliable, redundant connectivity between systems and computers that are physically separated using common data transfer protocols (IAB, 2005). Likewise, the Internet is a distinctive advertising medium, as a result of its unlimited capacity for interaction and content. The concept of advertising, from a marketing perspective, is defined as "any form of promotion or presentation of the ideas, goods and services of an identified sponsor" (Kotler & Armstrong, 1996, p. 461). The combination of the two concepts—marketing and the Internet—unfortunately, does not provide a perfect description of Internet marketing; accordingly, a cross-cutting perspective is required in order to take in the distinctive elements. Imber and Betsy-Ann (2000; as cited in Ngai, 2003, p. 24) told us that Internet marketing might be defined as "the process of constructing and maintaining customer relationships by electronic means and online activities, thereby facilitating the exchange of ideas, goods and services in a way that meets the needs of both buyers and sellers".

Greater Significance of Internet Marketing

Advertising over the Internet is continually growing and expanding; research carried out on advertising by Zenith Optimedia predicted that in the years of 2008, 2009 and 2010, the use of advertising by companies would continue to grow despite of the economic recession and the Internet would be the medium that would benefit most from this growth—unlike newspapers, magazines and radio, which would see their income from this source diminishing.

The Internet and Its Use in Business

The significance of the Internet as a tool for organizations to market and advertise their goods and services is obvious; however, the Internet can also be used as a tool for companies to establish a relationship with their customers and this will have a great impact on their assets; by creating a relationship between companies and their customers, the former will be able to deal with and follow up any complaints submitted by the latter and

furthermore, companies will be able to obtain direct information on consumers' tastes and preferences, which is extremely useful when marketing a company's goods and/or services.

Likewise, Currás and Küster (2003) reported that Internet enabled this exchange of information between companies and customers at very little cost, and at the same time allowed companies to obtain first-hand, useful information that would help them to improve the quality of their goods and services and engaged in one-to-one marketing, duly customizing their messages, goods or services to meet customers' needs or desires. Here again, the Internet is perfect for what is known as "defensive marketing", i.e., when a customer is dissatisfied, a company is able to handle complaints and claims much more speedily and efficiently, and what is more important, in real time. The Internet also enables companies to adopt any necessary measures to retain their clients, thanks to its unique flexibility and the possibility of customizing messages. Leaving aside the economic aspects, it is important to point out that the establishment of stable, long-lasting relationships between companies and customers also involves a certain social aspect, which requires great efforts by organizations, particularly in terms of rapport, contact, social skills, etc. (Alet, 1994; Vázquez, Días, & Del Río, 2000).

Electronic Social Networks

According to Celaya (2009, p. 92), in his *The Company in Web 2.0*, social networks "are Internet sites where people publish and share all types of information with third parties, acquaintances and complete strangers". This author quoted the following—more formal—definition from Wikipedia (2010): "a social network is a social structure that can be represented in the form of one or more graphs, where the nodes represent the individuals and the relationships between them"[1]. He believed that the importance of social networks lied in their current and near future role as a platform for exchanges and recommendations among people, thereby expediting the search processes for certain goods and services on the Web. In his book, the author went on to mention the types of social networks on the Internet, basically classifying them by their "purpose" for users. The breakdown would be: (1) professional networks; (2) general networks; and (3) specialized networks. The first, as the name indicates, are more professional in nature and business-oriented. The second are more social in nature and include networks for user interaction at a personal level. The third type—the specialized networks—as the name indicates, specializes in a specific social or economic activity (see Figure 1).

Dissemination of Social Networks

The way in which social networks expand or disseminate can be explained in terms of the networking effect and by "Metcalfe's Law", according to which "the value of a network for a person wishing to join is proportional to the square of the number of its users" (Katz, Chrousos, & Wu, 2008, p. 2). Metcalfe's Law, however, raises two types of problems: (1) It is impossible to project the value of a network ad infinitum, i.e., the negative effects of the network mean that at a specific point in time, the incremental value of the network tends to diminish with the number of members; and (2) This is related to the latter, not all members of a network have the same value. These two negative aspects are highly relevant, since they question whether the effect of the network, which is a basic driving force in the development of these platforms, may diminish. Bearing this in mind, whenever a network becomes obsolete because of the negative effects of the network itself, the problem may be solved by using a different platform.

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[1] Retrieved from http://en.wikipedia.org/wiki/Social_network.
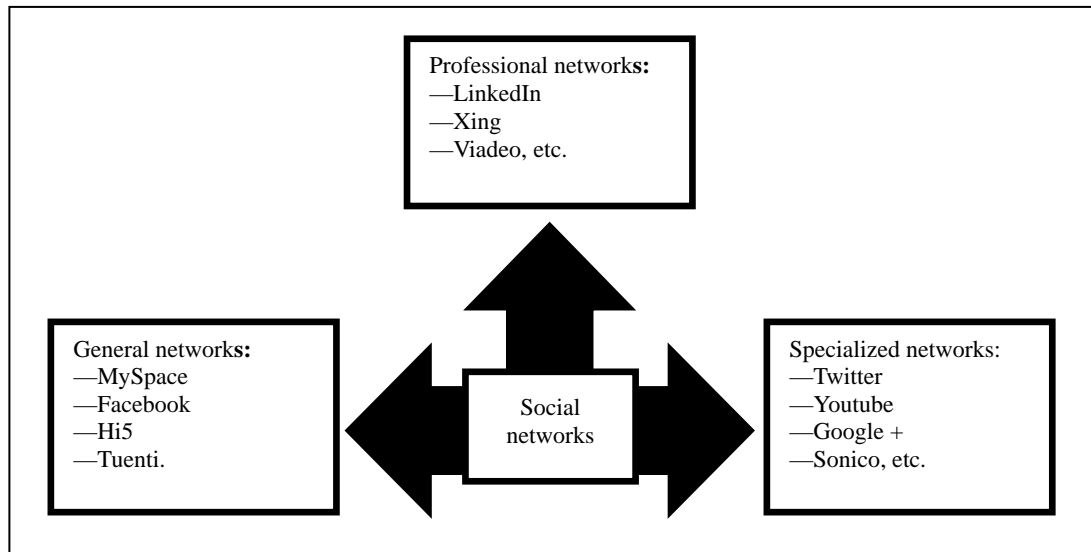
Figure 1. Types of social networks.

Economic Significance and the Use of Social Networks

An evaluation, in financial terms, of social networks nowadays, would result in overwhelming amounts; for example, in September 2007, MySpace and Facebook were valued at 15 billion USD—a figure that was much higher, in both cases, than their sales volume. It is important to point out that the value of the social network business depends on its capacity to monetize the relationship with each person who is a member of the network; it also depends on increasing or at least stabilizing the critical mass of users. Unlike other tools, social networks (e.g., Facebook) are used mainly for interaction among users and as a result, its sales generation rate is 1% compared to Google's 40%.

Companies can also use social networking sites to obtain detailed information on key personality features, hobbies, customs and culture of users and can use this information to define advertising and marketing strategies for their products and services that are duly oriented to the different consumer markets. Accordingly, companies have different options available to them when deciding on whether to join this type of social networks. These options are defined by Celaya (2009), as follows:

(1) Creating a corporate profile: When a company creates a public profile in respect of its product or service, the so-called corporate presence in this type of social network is not perceived as intrusive by users, since they themselves decide whether to include the profile or not in their list of accepted contacts;

(2) Creating a special interest group: Companies can create an interest group inside the platform for people who are potentially interested in the company or in its products and services;

(3) Market segmentation: This type of social network allows segmentation based on personal features, shared interests, socio-demographic characteristics, etc., which might prove to be highly useful to some companies;

(4) Survey: Social networks can be used to send questionnaires out to consumers and to collect users' information and opinions that will enable companies to improve their products and services, and likewise, to better focus their advertising;

(5) Studying users' behaviour: By studying the behaviour or conduct of social network users, companies can discover who is the person or group that starts the word-of-mouth process, which leads to dissemination of

a certain product, who buys a product and who does not, etc.;

(6) Customer service: Companies can use social networks to keep their customers updated on any changes, offers or launching of products and services; they can also use them to create open opinion forums about their products and services—real communication channels where they can obtain after-sales information to facilitate monitoring;

(7) Online advertising: All social networks provide an option for promotional and marketing activities on their pages, using banners, video uploading, bulletin boards, etc.

All of the above underline the important role of new technologies nowadays and their application not only in business but in the everyday life of societies. This is only the beginning of a technological revolution that will gradually transform the way in which we conceive the world today.

Proposed Hypotheses

Having reviewed the existing literature on the subject of the Internet and its application in the business world, and likewise, social networking, the next stage in this research involves the development of a number of hypotheses that will be examined, rationalized and contrasted.

According to Muela (2008), one of the greatest achievements of the Internet was that it had enabled access to all types of advertisers, of any size or nature. This means that any company can compete in equal conditions, no matter what its size, financial resources or location is. Many advertisers have realized that the Internet is the ideal medium to promote goods and services and that the appropriate use of available tools contributes greatly to their opening-up new markets, growing their client portfolio and consequently, increasing the organization's sales and profits; therefore, based on the above rationale, the following research hypotheses are proposed (see Figure 2):
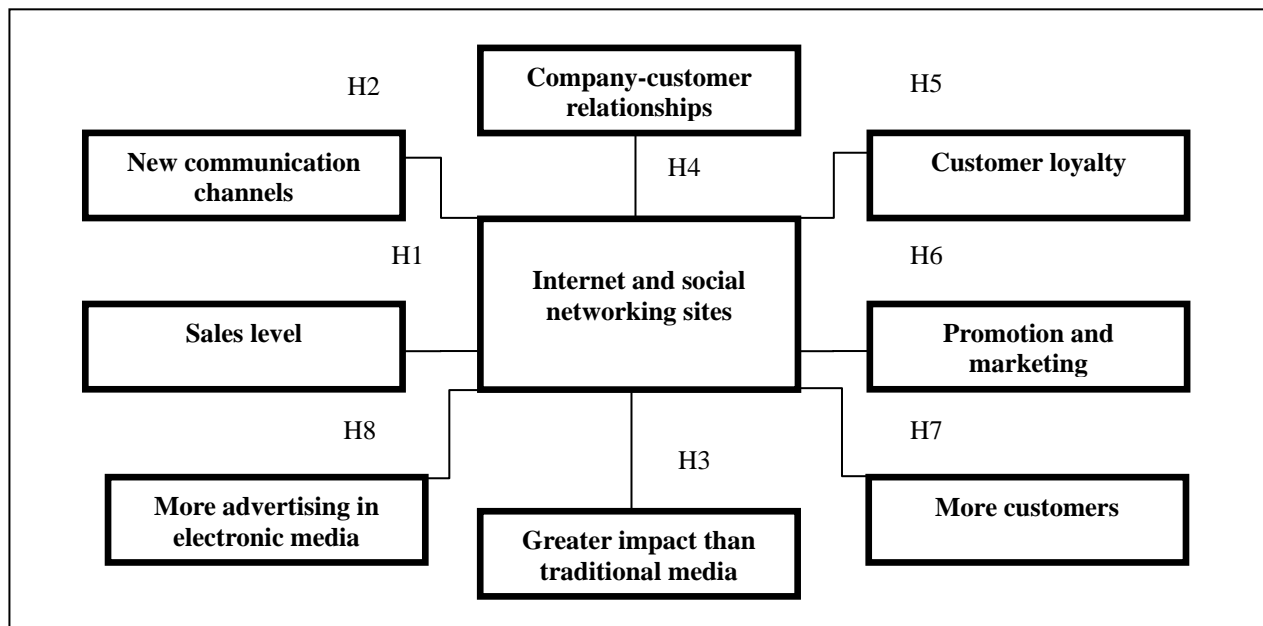

Figure 2. Proposed research model.

(1) H1: The use of Internet-based marketing tools contributes significantly to increasing a company's sales level.

Internet advertising and marketing is a multifarious form of marketing and/or advertising that is not constrained by space or time and possibilitates a different form of communication and interaction with consumers (McMillan, 2004). The true potential of Internet marketing lies in its capacity for using videos, animation, audio, images or graphics to communicate a company's product or service. Nonetheless, it is a tool that also has the capacity for interaction (i.e., the capacity to allow two components to communicate) and for control and commitment regarding content, responsibility and opportunity (Liu & Schrum, 2002; McMillan & Hwang, 2002). This capacity gives Internet marketing a significant advantage in communication processes, compared to other forms of promotion and enables a two-way communication flow between consumers and their clients and/or suppliers, ensuring greater awareness of their needs and better rapport and engagement. Furthermore, the Internet is capable of creating highly customized forms of communication, which allow consumer relationships to be established on the basis of one-to-one and personal communication. Whenever a company takes this into account when marketing its products or services, consumers' intention-to-buy increases accordingly (Hoffman & Novak, 1996; Macias, 2003; McMillan, 2004); therefore, based on the above rationale, the following research hypothesis is proposed.

(2) H2: The use of Internet-based marketing tools contributes significantly to establishing new communication channels with customers and suppliers.

Internet has evolved to an extent where even the way in which advertising information reaches online consumers has changed, thus making former techniques and tools for commercial promotion obsolete. This is a result of the specialization of Internet users nowadays, who, thanks to the use of ad hoc applications that are designed to meet their tastes and preferences, are able to filter the type of commercial information they wish to view and to use this information when they decide to do so (for example, social networking sites on the Internet). Consequently, the Internet is constantly developing new advertising tools that enable a high level of segmentation of the public and messages that are more relevant to or more in tune with users' needs. Thus, electronic marketing has managed to add value to companies' activities and to change their conceptions of business strategies and at the same time, increase their profitability (Strauss & Frost, 2001). As a result, Internet advertising and marketing has experienced an exponential growth in recent years, mainly due to its characteristics, which can be summarized in low costs and a significantly-sized user market that is continually growing; these characteristics are far removed from the traditional media for promotion, which now see the Internet as their main rival. This was confirmed in recent studies, according to which Internet advertising increased by 24% in 2008 and was expected to increase by 69% by the year of 2010. Furthermore and significantly, Internet advertising was greater than radio advertising in 2008 and was predicted to be greater than magazine advertising by 2010. This being the case, the market share held by Internet advertising would increase from 8.1% to 9.4%; the share in outdoor and cinema advertising would also have increased significantly. Even if television—the medium most in demand—was to reach a larger public, it would only increase its share by two decimal points, rising from 37.7% to 37.9%; therefore, based on the above rationale, the following research hypothesis is proposed.

(3) H3: Internet advertising nowadays has a greater impact than traditional promotional media.

The significance of the Internet as a tool for organizations to market and advertise their goods and services is obvious; however, the Internet can also be used as a tool for companies to establish a relationship with their customers, something that will have a great impact on their assets; by creating a relationship between companies and their customers, the former will be able to deal with and follow up any complaints submitted by

the latter and furthermore, companies will be able to obtain direct information on consumers' tastes and preferences, which is extremely useful when marketing a company's goods and/or services. Likewise, Currás and Küster (2003) reported that Internet enabled this exchange of information between companies and customers at very little cost and at the same time, allowed companies to obtain first-hand, useful information that would help them to improve the quality of their goods and services and engaged in one-to-one marketing, offering individual clients the goods or services that best adapted to their needs or wishes, by sending customized messages. Leaving aside the economic aspects, it is also important to point out that the establishment of stable, long-lasting relationships between companies and customers also involves a certain social aspect, which requires great efforts by organizations, particularly in terms of rapport, contact, social skills, etc. (Alet, 1994; Vázquez et al., 2000); therefore, based on the above rationale, the following research hypothesis is proposed.

(4) H4: The use of the Internet and Internet-supported social networking sites contributes significantly to better company-customer relationships.

Some authors believe that the Internet is perfect for applying certain techniques, such as the technique known as "defensive marketing", i.e., when a customer is dissatisfied, a company is able to handle complaints and claims much more speedily and efficiently, and what is more important, in real time. The Internet also enables companies to adopt any necessary measures to retain their clients and ensure customer loyalty thanks to its unique flexibility and the possibility of customizing messages. Furthermore, a customer that is satisfied not only with the purchase of a product and/or service but also with the attention received, tends to value the company more and to take it into consideration for future purchases (Alet, 1994; Vázquez et al., 2000); therefore, based on the above rationale, the following research hypothesis is proposed.

(5) H5: The use of the Internet and social networks by companies as a medium for customer service contributes significantly to fostering customer loyalty.

Internet has enabled access to all types of advertisers; nowadays, any company, no matter what its size, financial resources or location is, can compete in equal conditions. Many advertisers have started to realize that the Internet is the ideal showcase to promote their goods and services and that it can enable them to implement strategies to create or build brand names. Current data confirm that by using the Internet, you can reach actual or potential consumers—wherever they may be, and at an appropriate time, show them commercial or advertising material. A further aspect to be borne in mind in the case of online advertising is the advantage in terms of cost, compared to traditional advertising; accordingly, there has been a significant increase in investment in online advertising (Muela, 2008); therefore, based on the above rationale, the following research hypothesis is proposed.

(6) H6: The use of the Internet and social networking sites by companies contributes significantly to better promotion and marketing of goods and services.

The practically exponential growth of the use of the Internet and social networking sites has contributed greatly to companies considering these to be useful tools for promoting and advertising their goods and/or services. According to Li and Leckenby (2004), the main consumer market on the Internet was comprised of young people. The younger generation is more in contact with electronic media and much more familiar with this phenomenon; accordingly, the capacity of these tools for expansion and for handling large numbers of users make them attractive with regards to the number of potential consumers and the ease with which advertising messages can be sent, at a low cost and to a greater number of spectators; therefore, based on the

above rationale, the following research hypothesis is proposed.

(7) H7: The use of the Internet and social networks by companies contributes significantly to increasing the number of potential customers.

According to authors, such as Katz, Chrousos and Wu (2008), the so-called non-transactional Internet model was based on the sale of advertising space. Social networks aim at increasing this potential source of income by studying users' behaviour on the Web in order to identify market sub-segments and users' tastes and needs. Accordingly, they are efficient media for advertising and marketing a company's goods and/or services—on the one hand, because of their accessibility and on the other hand, because of the technological advance involved, particularly, if we take into account the low cost of using these tools and the number of potential customers to be found in these networks; therefore, based on the above rationale, the following research hypothesis is proposed.

(8) H8: Social networks will contribute significantly to companies using electronic media for advertising.

Based on the previous hypotheses, the following theoretical model is proposed and will be contrasted with a statistical analysis.

Methodology

The data collection process for this research involved creating an instrument or questionnaire in which a five-level Likert-type scale was used to develop four five-level Likert items relating to the component that influenced sales levels; six five-level Likert items relating to distribution and communication channels; four five-level Likert items relating to the customers-service-loyalty component; six five-level Likert items relating to marketing and promotion of goods and services; six five-level Likert items comparing the opinion of entrepreneurs and users in general on the use of the Internet and social networking sites; five five-level Likert items comparing the opinion of entrepreneurs and users in general on brands as promotion tools; five five-level Likert items relating to satisfaction and loyalty of users of the Internet and social networks as a platform for doing business; and three five-level Likert items relating to customer loyalty. Likewise, the study population was defined as people between 18 and 70 years of age that were related to the business context in Alicante. The questionnaire was available in Spanish and was distributed randomly to different companies in the Alicante area (Spain), on April 5-30, 2011. The total number of valid questionnaires was 405. The data obtained were analyzed based on statistical techniques using software, such as EQS (v. 6.1) and SPSS (v. 15). The following are the results of the analysis.

Results and Discussion

Descriptive Analysis

The main objective is to make a descriptive analysis of the indicators that define the latent variables that will be used in subsequent statistical analyses. During this stage, the median of the indicators was analyzed and an ANOVA (Analysis of Variance) analysis made to determine mean values and also their level of significance (see Table 1).

The results shown in Table 1 indicate that the most valued aspects are related to the use of new technologies in business activities. Furthermore, the least valued aspect is related to customer loyalty and reward using ICTs as a platform. Even so, the respondents scored the majority of the items favourably.

Table 1

Descriptive Analysis

Construct	Question	Typology	Median	P^*
Sales' level and customer capture	P.2.1	Entrepreneurs	3.16	0.007
	P.2.2	Entrepreneurs	3.31	0.000
	P.2.3	Entrepreneurs	3.19	0.020
	P.2.4	Entrepreneurs	3.10	0.000
Distribution and communication channels	P.3.1	Entrepreneurs	3.67	0.000
	P.3.2	Entrepreneurs	3.61	0.001
	P.3.3	Entrepreneurs	3.52	0.000
	P.3.4	Entrepreneurs	3.50	0.000
	P.3.5	Entrepreneurs	3.53	0.005
	P.3.6	Entrepreneurs	3.12	0.000
Customers-satisfaction-service-loyalty	P.4.1	Entrepreneurs	3.27	0.000
	P.4.2	Entrepreneurs	3.20	0.008
	P.4.3	Entrepreneurs	3.29	0.000
	P.4.4	Entrepreneurs	3.15	0.000
Promotion and marketing of goods and services	P.5.1	Entrepreneurs	3.95	0.099
	P.5.2	Entrepreneurs	3.49	0.000
	P.5.3	Entrepreneurs	3.29	0.000
	P.5.4	Entrepreneurs	3.67	0.000
	P.5.5	Entrepreneurs	3.47	0.011
	P.5.6	Entrepreneurs	3.19	0.000
Use of the Internet and social networking sites at a business level	P.6emp.1	Entrepreneurs	3.96	0.000
	P.6emp.2	Entrepreneurs	3.55	0.000
	P.6emp.3	Entrepreneurs	3.76	0.000
	P.6emp.4	Entrepreneurs	3.70	0.000
	P.6emp.5	Entrepreneurs	3.80	0.000
	P.6emp.6	Entrepreneurs	4.36	0.000
Brands as a tool for promoting a company	P.7emp.1	Entrepreneurs	4.03	0.000
	P.7emp.2	Entrepreneurs	3.80	0.000
	P.7emp.3	Entrepreneurs	3.74	0.000
	P.7emp.4	Entrepreneurs	3.27	0.066
	P.7emp.5	Entrepreneurs	3.53	0.000
Satisfaction and loyalty of Internet and social network users	P.8.1	Entrepreneurs	3.53	0.000
	P.8.2	Entrepreneurs	3.38	0.000
	P.8.3	Entrepreneurs	3.25	0.000
	P.8.4	Entrepreneurs	3.16	0.000
	P.8.5	Entrepreneurs	3.01	0.000
Loyalty and/or reward	P.9.1	Entrepreneurs	3.04	0.000
	P.9.2	Entrepreneurs	2.91	0.000
	P.9.3	Entrepreneurs	2.90	0.000

Note. $^* P < 0.05$.

Reliability and Validity of the Questionnaire

On completion of the data exploratory analysis, a covariance model was used to analyze the manifest and latent variables. Nonetheless, prior to the structural analysis, the psychometric properties of the questionnaire were evaluated (Anderson & Gerbing, 1988). The evaluation of reliability and validity of the questionnaire

involved various steps: first, a confirmatory factor analysis was made of the factors previously described for the measuring scales (expectations, satisfaction, quality and performance), using the method of maximum verisimilitude. Items whose factor loading was not significant or was lower than 0.6 were eliminated to ensure good representation and convergent validity of the questionnaire (Bagozzi & Baumgartner, 1994; Bagozzi & Yi, 1988). The definitive version of the questionnaire following this stage is shown in Table 2. The total of the goodness-of-fit measures for the model shows reasonably good values, close to 0.80, which is considered as an acceptable value (Lévy et al., 2003): BBNFI[2] = 0.842; BBNNFI[3] = 0.838; CFI[4] = 0.906. Likewise, the Root Mean Square Error of Approximation for the population (RMSEA) is 0.092, which can also be considered acceptable (Bollen, 1989). These three measures support the idea that the goodness-of-fit of the model is acceptable; accordingly, based on the goodness-of-fit of the measuring model and the fact that practically all of the loading factors are significant and greater than 0.6, it can be concluded that the proposed instrument has convergent validity.

In the case of reliability (see Table 2), Cronbach's α (1951) is higher than the recommended value of 0.7 (Churchill, 1979; Nunnally, 1978). Bearing in mind the limitations inherent to this first measure, the composite reliability index and the average variance extracted index (AVE) have also been determined. In the case of the composite reliability index (see Table 2), all values are higher than the recommended value of 0.7 (Fornell & Larcker, 1981). Likewise, the AVE shows values higher than or close to 0.5, which is the recommended value. A global consideration of these three indicators proves that the study instrument is reliable. Lastly, based on the confidence interval test (Anderson & Gerbing, 1988), we can say that all of the values lie within a range of less than 1; accordingly, the discriminant validity of the measured scales is confirmed.

Table 2

Measuring Instrument: Reliability and Convergent Validity

Scale	Indicator	Standard loading	IFC[5]	IVE[6]
Sales' levels and customer capture	P.2.1	0.854		
	P.2.2	0.738	0.782	0.598
	P.2.3	0.798		
	P.2.4	0.889		
Distribution and communication channels	P.3.1	0.615		
	P.3.2	0.732	0.778	0.581
	P.3.3	0.824		
	P.3.6	0.845		
Customers-satisfaction-service-loyalty	P.4.1	0.875		
	P.4.2	0.816	0.787	0.591
	P.4.3	0.869		
	P.4.4	0.814		
Promotion and marketing of goods and services	P.5.1	0.874	0.701	0.587

(to be continued)

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[2] Bentler-Bonett Normed Fixed Index.
[3] Bentler-Bonett Non-normed Fixed Index.
[4] Comparative Fit Index.
[5] Composite Reliability Index.
[6] Variance Extracted Index.

	P.5.4	0.749		
	P.5.5	0.889		
	P.5.6	0.805		
Use of the Internet and social networking sites at a business level	P.6emp.1	0.804		
	P.6emp.2	0.786		
	P.6emp.3	0.795	0.796	0.580
	P.6emp.4	0.806		
	P.6emp.5	0.704		
	P.6emp.6	0.822		
Use of the Internet and social networking sites at a personal level	P.6gral.1	0.841		
	P.6gral.2	0.873		
	P.6gral.3	0.824	0.754	0.577
	P.6gral.4	0.798		
	P.6gral.5	0.784		
Brands as tools for promoting companies	P.7emp.1	0.816		
	P.7emp.2	0.884		
	P.7emp.3	0.765	0.740	0.609
	P.7emp.5	0.832		
Brands as tools for promoting products and services	P.7gral.1	0.776		
	P.7gral.2	0.699		
	P.7gral.3	0.805	0.749	0.684
	P.7gral.4	0.793		
	P.7gral.5	0.799		
Satisfaction and loyalty of users of the Internet and social networking sites as a platform for doing business	P.8.1	0.814		
	P.8.2	0.798		
	P.8.3	0.793	0.703	0.591
	P.8.4	0.746		
	P.8.5	0.882		
Loyalty and/or reward as a result of using the Internet and social networking sites	P.9.1	0.828		
	P.9.2	0.965	0.731	0.584
	P.9.3	0.826		

Hypothesis Test

Table 3

Hypotheses Test

Hypothesis	Standard loading	T-value
H1: ICTs— > (+) Sales levels	0.719	7.451[**]
H2: ICTs— > (+) New communication channels	0.729	8.179[**]
H3: ICTs— > (+) Greater impact than traditional media	0.781	7.641[**]
H4: ICTs— > (+) Company-customer relationships	0.793	8.632[**]
H5: ICTs— >(+) Loyalty	0.745	7.952[**]
H6: ICTs— >(+) Promotion and marketing	0.736	7.641[**]
H7: ICTs— >(+) More customers	0.765	7.294[**]
H8: ICTs— >(+) More advertising in electronic media	0.749	7.352[**]
Chi-square = 2,563.224 (142 gl; $P < 0.01$); BBNFI = 0.791; BBNNFI = 0.787; CFI = 0.781; RMSEA = 0.135		

Note. [**] $P < 0.01$.

Having evaluated the psychometric properties of the measuring instrument, the structural model was then

evaluated using the method of maximum verisimilitude and EQS 6.1 software (Bentler, 1989).

As shown in Table 3, the relationships initially proposed in the theoretical model proved to be significant. Furthermore, it can be seen that the fit of the structural model is good in respect of the measuring model, as indicated by the fit indices: BNNFI = 0.791; BBNNFI = 0.787; CFI = 0.781; RMSEA = 0.135 or Chi-square = 2563.224 (142 gl, $P < 0.01$). These results would lead us to believe that the proposed, contrasted model might serve as a basis for analyzing the relationship between the different factors involved in the use and application of new technologies in the business world.

Conclusions

Conclusions and Implications for Management

Having analyzed the research hypotheses, we can conclude that new technologies have a great impact and influence on the way in which business is done nowadays. It is extremely important to underline, as stated in the literature, that the use of ICTs has contributed to improving communication at a global level, increased the communication flow and reduced the time and cost of communications. Furthermore, ICTs have become a significant platform for promoting and marketing goods and services and this has played a significant part in the increase of trade worldwide.

Limitations and Future Lines of Research

The limitations of this research lie in the size of the sample and its application, since it focussed only on companies in Alicante (Spain). Therefore, for this type of research to be more representative, future lines of research should include a greater number of companies located in other regions.

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The Learning Processes in Technological Capabilities' Accumulation: A Case Study in Small Goat Husbandry Firms

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This research seeks to characterize the technological capacities in small firms of the goat husbandry productive chain in the state of Ceará, Brazil. The implications of the underlying learning processes in the dynamics of the accumulation of technological capabilities in the firms studied were verified and based on the following questions: Which levels and types of technological capabilities have the firms done under present study? Which are the implications of the underlying learning processes in the accumulation of the technological capabilities? The methodological scope of comparative case study was used for this research. The data analysis started from the collection and compilation of documents and interviews, using semi-structured scripts, based on the thematic analysis of contents, referring to the following technological process: management of the productive unit; articulations established in the context of the productive chain; and handling processes and organization of production. The results described the competence levels for the studied technological process, also evidencing the practical implications of different learning processes about the accumulation of the technological capabilities in the firms under study. The article's contribution is notable when adapting the analytic structures for technological capacities' accumulation and learning processes in the context of small firms that participate in the agribusiness sector productive chain.

Keywords: technological capabilities, learning processes, small firms, productive chain

Starting from the beginning of the 1990s, with the arrival of the knowledge and learning economy paradigm, the importance of creativity and innovative technological capabilities was emphasized for the

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competitiveness of businesses in emerging economies (latecomers). In that context, several studies were based on the discussion about the strategic role of innovation and development of technological capabilities, being those based on the approach of "dynamic capabilities", when emphasizing the constant change of the paths, in terms of timing and speed, of technological accumulation through the underlying learning processes and the implications of that process for the innovative performance (Lall, 1987; Leonard-Barton, 1990; Kim, 1995; Dutrénit, 2000; Figueiredo, 2003).

The firms need to engage in deliberate technological learning processes to develop their internal knowledge bases and accumulate technological capacities. Such learning processes, both intra- and/or inter-company developed through internal sources and external technological links, are understood here as inputs that facilitate the build-up of technological competence over time, finally influencing the competitive capacity of those firms (Zollo & Winter, 2002; Bell, 2006).

This technological capacity is defined by Bell and Pavitt (1995) as being the necessary resources to generate and manage the dynamism and the technological changes, and being these resources to incorporate in individuals, through their aptitudes, knowledge and experiences; as also in organizational systems.

Several studies approached both accumulation processes and technological learning and verified the implications on the organizational performance. Such works were accomplished in sectors like metal-mechanics (Büttenbender, 2001), and information and communication technologies (Marins, 2005), among others.

There is a need for expansion of empiric studies for different types of firms in order to generate knowledge about the accumulation process of technological capabilities. This research joins in this study field, differing when focusing on an important sector of Brazil, the agribusiness, and in the context of small firms that participate in the goat husbandry productive chain in Northeastern Brazil.

China, India, and Pakistan, followed by Australia, have the largest goat herds, with, respectively, 17.33%, 14.59%, 6.58% and 7.33% of the world herd. Brazil has 1.10% of the goat herd, in spite of possessing, mainly in the Northeast area, the same or even better edaphoclimatic conditions than the countries that are the larger breeders of the species. The Northeastern area of Brazil deserves the spotlight in the exploration of goat husbandry with more than eight million heads, which represents about 90% of the total national goat herd (IBGE, 2009; FAO, 2009).

Northeastern Brazil appears to have great potential in the exploration of this activity; however, the region does not realize this potential due to obstacles that limit its development. In order for goat husbandry in the Brazilian Northeast to become an economically maintainable business, it is vital that programs and policies are implemented that are aimed at the adoption and development of economically viable technologies in the area. There also should be studies that evaluate the technological overview of the activity.

In this context, some studies presented contributions evaluating the technological level of small- and medium-sized companies which participate in different productive chains (Gereffi & Kaplinsky, 2001; Humphrey & Schmitz, 2000). Several studies presented contributions for the evaluation of the technological level in the goat husbandry area (EMBRAPA, 1989; Campos, 2004). These studies, however, didn't establish a specific relationship between level and technological dynamics observed and the learning processes developed by the appraised firm.

Therefore, the article seeks to contribute in this sense. It has an objective to characterize the technological capacities and analyze the implications of the underlying learning processes in the dynamics of the

accumulation of technological capabilities in small firms in the goat husbandry productive chain. The paper is based on the following questions: Which levels and types of technological capabilities do the firms under present study? Which are the implications of the underlying learning processes in the accumulation of the technological capabilities?

The methodological scope of this study was the qualitative approach between four case studies, using several techniques of gathering and triangulation of information (Yin, 1994). For the choice of the cases, firms associated with CAPRILEICE (Dairy Goat Breeders Association of Ceará, Brazil) were used as selection criteria.

The next sections will present the analytical basis of study, empiric context, method, results and final consideration of the research.

Analytical Basis of Study

Concerning the existent definitions in literature characterizing technological capacities, particularly in the context of companies of industrialized economies, Katz (1987) approached it as an inventive activity or a systematic creative effort to obtain new knowledge. However, according to Lall's definition (1987), it was an internal technological effort to acquire the domain of new technologies, to adapt and improve them.

This study's basis is the definition proposed by Bell and Pavitt (1995), which acclaims that the technological capacity is of a diffuse nature, and it incorporates the necessary resources (or knowledge stocks) to generate and manage technological changes. Such resources accumulate and incorporate in the individuals (aptitudes, knowledge and experience), and mainly in the organizational systems, routines and procedures of the company (Figueiredo, 2003).

It is through the technological capacity that companies accomplish production and innovation activities. The perspective about innovation adopted in this study is in consonance with that described in the Manual of Oslo (OECD, 2002). It defines innovation as a continuous process with growing degrees and/or complexity apprenticeships, involving the resolution of problems around different activities, demanding that capacity stocks and specific learning processes to the companies and other organization types, being this process influenced by the nature of the institutional context in which they are inserted (Dosi, 1988).

It is understood that the technological capacity or the internal knowledge base of a firm, or even of a department, is accumulated in four components: (1) physical system—equipment, software, machinery; (2) people—tacit knowledge, abilities and acquired experiences over time by people, known as the human capital of the organization; (3) organizational system—the knowledge that is accumulated in the organizational and managerial routines of the organization; and (4) products and services—this component refers to the part of the technological capacity that can be seen and that is a result of the acquired tacit knowledge by the organization and its members (Bell & Pavitt, 1995).

There are several methods for the analysis of the innovative performance of companies. Bell and Pavitt (1995) presented a taxonomy to understand the construction process of technological capacities in industrial companies. This method allows for the identification of the technological capacities' profile at different levels of different types of companies.

The method developed by Figueiredo (2003) which was built based on studies developed by Bell and Pavitt (1995), had as a base the original model elaborated by Lall (1992), classified the technological capabilities in routine and innovative activities, divided in different types and levels according to the

complexity degree. That author defined the routine technological capabilities (or production capacities) as the necessary aptitudes to use a technology, knowledge or organizational mechanisms. On the other hand, the innovative technological capabilities (innovation capabilities) are those that allow creating, modifying or improving products or processes, modifying the technologies, knowledge and organizational mechanisms (Figueiredo, 2003).

Beginning in the 1970s, studies addressed to technology in developing countries took a more dynamic direction. They focused on the changes that happened over time and by the way firms had executed them, challenging, therefore, the perspective of "technological dependence" that dominated the study field on technological innovation management in that context (Bell, 2006).

The studies related to the development of their own technological capacities demonstrated existent relevance to the involvement of firms in the generation of technical knowledge for the creation of those capacities (Katz, 1987). According to Bell (1984), above all in the long term, the accumulation of those competences was a necessary condition to technical evolution. These studies aimed at the underlying learning mechanisms focusing, however, on the acquisition of knowledge, and not the conversion of individual learning processes in the organizations.

Starting in the early 1990s, studies on the development of innovative technological capabilities of companies located in emerging countries have taken a broader perspective than the earlier ones. Such studies started to address the focus on organizational and managerial dimensions of the technological capabilities accumulation process, the learning mechanisms and construction of the knowledge and lastly on the specificities of the firm and the consequences of these on the managerial performance (Leonard-Barton, 1990; Lall, 1987; Dutrénit, 2000; Figueiredo, 2003).

In 1987, Lall approached the discussion on the paths of technological capabilities' accumulation in a study of Indian industries. The results demonstrated a transition sequence from basic levels to higher levels of acquisition of technological competences and verified the influence of government policies on the studied industries.

Studies performed by Leonard-Barton (1990) evidenced that the increments accomplished in equipment, products and processes of the studied companies were associated to the invigoration and the renewal of the basic competences of those companies. These competences were classified by this author in four dimensions: technical systems; employees' training; managerial systems; and values and norms. These studies, however, did not evaluate the evolution of those competences over a long period, nor did they piece together comparisons among the studied companies.

Kim (1995) completed case studies at Hyundai Motors and Samsung Electronics. They demonstrated the importance of the learning conversion processes from individual to organizational. On the other hand, the study accomplished by Dutrénit (2000) in a Mexican glass company demonstrated the importance of the intra-managerial learning processes in the accumulation of technological competences in the studied reality.

The studies which analyzed border technology companies dedicated attention to the processes that were underlying in the generation path of technological competences. The studies developed by Cohen and Levinthal (1990) and Leonard-Barton (1990) demonstrated the importance of the incorporation of external knowledge for the development of competences or innovative capacities. The studies at border technology companies still approached the processes of learning conversion from individual to organizational, according to Nonaka and Takeuchi (1997). Meetings, training at work and sharing of experiences, are examples of mechanisms that can

be taken to the socialization of knowledge.

During the analysis of existing studies related to companies located in emerging countries, it became notable that a great part of these researches were directed to the description of the companies' accumulation of technological capabilities paths, not creating, however, a relationship between its path and the underlying learning processes. A great part of the completed studies at border technology companies are directed at understanding the way, by which those organizations maintain and renew the already existent technological capabilities and accumulated ones. These studies have not focused on the way, by which they reached those competences over time, which is of primordial importance for the emerging countries companies.

In that sense, recent studies (Figueiredo, 2003) have looked to rescue, in the context of the latecomers, the dynamic perspective of the first studies of the 1970s. The understanding of the dynamics in the process of technological accumulation is fundamental in the context of emerging economies. In order for those companies to reach the technological border, it is necessary for them to accelerate the process of technological accumulation at a rate proportionally faster than the one observed in companies of industrialized economies (Miranda & Figueiredo, 2010).

This study will consider the technological learning perspective that defines it as a deliberate process in which knowledge and competence are acquired by the individuals and converted through them to the organizations, finally influencing the evolution of dynamic capacities (Bell, 1984; Zollo & Winter, 2002).

Figueiredo (2003), however, considered it as a process that allowed a company to accumulate technological capacity over time. According to Bell (1984), learning was divided into two processes: one of acquisition, which was of an individual ambit; and the one of conversion, which was of an organizational ambit. This way, an organization directed to learning is the one capable to generate, acquire and transmit knowledge, allowing the production of continuous improvements.

The construct of the technological learning is operated in this research based on several mechanisms that the companies use to acquire different types of knowledge from different sources, both internal and external, having as a scope the build-up of its technological capacities. Several models of learning analysis are available in the literature (Kim, 1995; Nonaka & Takeuchi, 1997).

This study will use the analytic model developed by Figueiredo (2003) that is based on the studies of Nonaka and Takeuchi (1997), in which the learning processes are classified in four characteristics which are organized into four levels: (1) internal acquisition of knowledge—they are the learning mechanisms by which individuals acquire tacit knowledge through different activities accomplished inside of the company; (2) external acquisition of knowledge—they are those mechanisms by which individuals acquire tacit and/or codified knowledge out of the company; (3) socialization knowledge—they are the mechanisms by which individuals share the tacit knowledge (mental models and technical aptitudes); and (4) knowledge code—that are the learning mechanisms by which individual tacit knowledge, or part of it, becomes explicit.

Empiric Context of the Research

According to Holanda (2006), since the second half of the 1990s, the goat husbandry productive chain, especially the milk segment (see Figure 1) was established as priority for the development of the agricultural system of the Brazilian northeast.

Considering that institutional context, "PAA Leite" stands out (Incentive Program to Production and Consumption of Milk). It is classified as a modality of PAA (Victuals Acquisition Program) developed with

resources of MDS (Ministry of Social Development and Hunger Combat) and MDA (Ministry of Agrarian Development), as an instrument of public politics of the federal government countersigned in Law 10.696, of July 2, 2003, which has been stimulating the production of goat milk with the opening of new institutional markets.
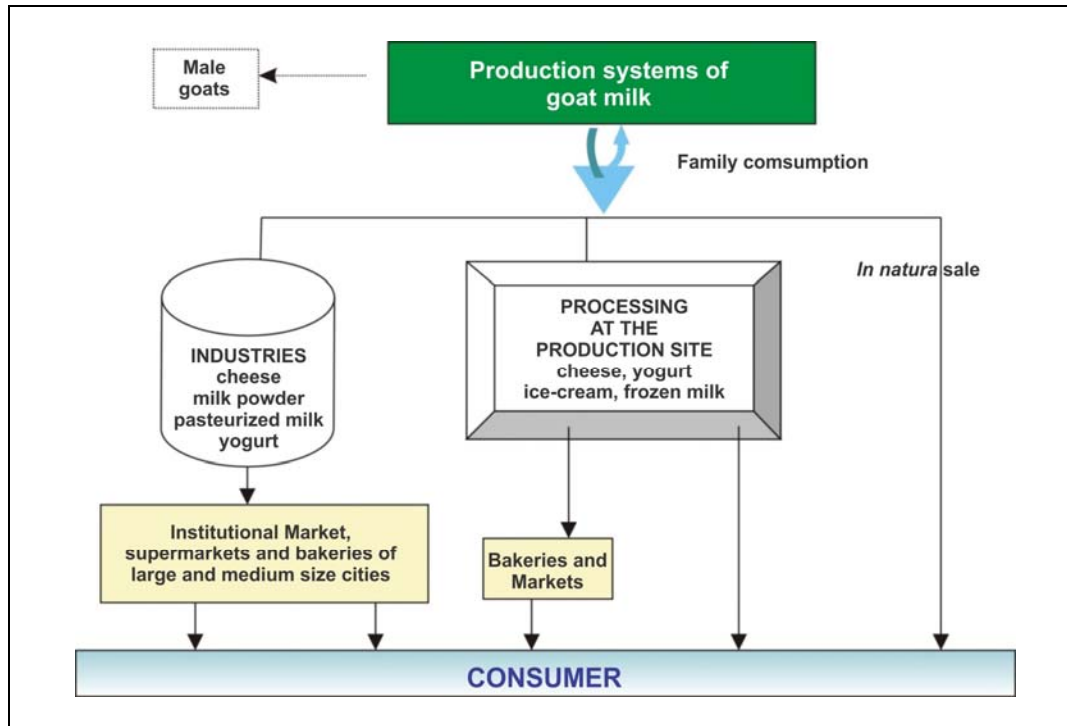
Figure 1. Commercialization flows of the dairy goat productive chain in Brazil. Source: Holanda (2006, p. 18).

Based on PAA and in the local ambit, the government of the state of Ceará started, in 2007, the "Incentive Program to Production and Consumption of Goat Milk" in the state (SDA, 2010). The program has an objective to support, provide and diffuse raising techniques of milk goat husbandry, seeking the improvement, economical viability and management of the activity, guaranteeing the participation of local producers in "PAA Leite" government programs.

To reach those objectives, since 2007 the companies participant of the goat husbandry productive chain inaugurated the activities of CAPRILEICE, which has among its objectives to motivate, strengthen and develop the dairy activity in every territory of the state of Ceará, Brazil.

However, in spite of that expressiveness and support, the northeast area still does not demonstrate the use of all its production potential. Nogueira Filho and Alves (2002) pointed out the following factors as obstacles to competitiveness and profitability in the exploration of goat husbandry in the market: the incipient technological diffusion, the inadequate technical and managerial attendance, the dislocation of the productive chain actors, the inexistence of market studies, the low level of training of producers, the high cost of genetic materials, the limited amount of feed and water resources and the lack of specialized laboratories.

For the exploration of goat husbandry to become a profitable and economically maintainable activity for the northeastern area, it is necessary to have the creation and implementation of actions addressed to overcome

those obstacles and motivate the development of the activity. They may include the use of technologies that are economically viable for the area, and that consider aspects such as innovation, interaction, cooperation, learning and articulation of institutional configurations.

Design and Method

The methodological scope of this study was the qualitative approach among four case studies, using several techniques of gathering and triangulation of information. In the study of cases, the data collection instruments can be diversified, which gives flexibility to the analysis. So, for us to obtain a high level of reliability, during the execution of this study, several techniques of information collection were used, such as informal and deepened interviews (Yin, 1994).

The construction of the evaluation method used for characterization of technological capacities in small firms that participate in the goat husbandry productive chain constitutes the first empiric stage of this research, being divided into three stages:

(1) Pre-pilot—it had an objective to construct a general panorama of the empiric context and to obtain data about the specific aspects of the participant firms of the productive chain related to the existing implanted technologies. It was characterized by the completion of informal interviews, a bibliographical survey and supporting documental compilation of the investigation through consultations of the institutional databases generated by the firms and the participant organizations of the goat husbandry productive chain, such as CAPRILEICE; the research and development institute—R&D of EMBRAPA (Brazilian Enterprise for Agricultural Research) Goats and Sheep; the state and Federal Departments of Agricultural Development; and the organs of technical attendance at EMATERCE (Technical Assistance and Rural Extension Company of Ceará), FAO (Food and Agriculture Organization of the United Nations), IBGE (Brazilian Institute of Geography and Statistics) and BNB (Bank of the Northeast of Brazil);

(2) Pilot—characterized by the adaptation procedures of the method to the reality in study that occurred through the organization of secondary data and collection of primary data obtained by the composition of a group of 12 specialists of the sector and the accomplishment of deep interviews with those specialists, among these: two technicians from EMATERCE; one teacher from the Animal Science Postgraduate Program of UFC (Federal University of Ceará); four researchers from RENORBIO (Northeast Biotechnology Network), linked to the laboratorial complex of Veterinary School of UECE (State University of Ceará); four researchers from EMBRAPA Goats and Sheep; one consultant from the Ministry of Science and Technology, linked to SIBRATEC (Brazilian System Technology) R&D network;

(3) Validation—characterized by the accomplishment of direct observations and five semi-structured interviews with the owners of small firms associated to CAPRILEICE selected for this stage of the study.

In the second empiric stage of this research, semi-structured interviews were accomplished with the managers of four participant firms in the goat husbandry productive chain. Those interviews were accomplished with the purpose of proceeding the investigation of the learning processes, as well as the levels of technological capacity.

For the gathering of data, the firms' owners were interviewed using semi-structured scripts for the purpose of knowing the historical evolution of each firm. At this time, the development stages of the firms were from 2000 to 2011. Later, the observations and interviews that proceeded were based on the scripts and evaluation forms of processes/functions/levels related to the technological capacities under study.

This collected material was analyzed based on the thematic analysis technique, which was in the group of analysis of content techniques (Bardin, 1977). For the final analysis, the obtained evidences were described comparatively, related and organized in figures and tables.

Results

A characterization and the comparative analysis will be presented in this section, based on the discussion of the joined results evidenced in firms studied.

Characterization of Technological Capacities in Small Firms That Participate in the Goat Husbandry Productive Chain

With the purpose of analyzing the levels of technological capabilities in the empiric field approached in this study, an adaptation was made to the method used by Figueiredo (2003), which was built based on studies developed by Bell and Pavitt (1995) and based on the original model elaborated by Lall (1992).

Given the specificities of the firms under study and considering the context of the goat husbandry productive chain, the adapted model for this research was constituted of six competences levels for three technological functions. According to Table 1, the columns present the technological functions/processes for the studied sector, having the following descriptions:

(1) Management of the productive unit—this function covers activities related to facilities, bookkeeping and genealogical and technical cataloging of the herd's data;

(2) Handling processes and organization of production—subdivided into three other functions:

(a) Nutrition—this function covers the activities referring to the nutritious handling of the animals;

(b) Sanitation—this function regards the activities concerning the care with the hygiene and endemic controls of the herd;

(c) Reproduction—it describes the activities aimed at the accomplishment of the reproductive handling of the animals on the properties;

(3) Articulations established in the context of the productive chain—these processes involve the interactions between the firms and other organizations of the influential institutional environment in the context of the chain, among these: suppliers, universities and R&D laboratories, entrepreneur associations and other government public and private organizations, such as the Department of Agricultural Development.

Table 1

Model of Analysis of Technological Capacities for Small Firms' Participant in the Goat Husbandry Productive Chain

Level of technological capacity	Technological function and related activity		
	Management of productive unit	Handling and organization of production related to the processes of nutrition/sanitation/reproduction	Articulations in the context of the productive chain
1—Basic routine	Mechanisms of property management and basic annotations related to the general control of the herd; technical attendance at incipient level.	Feed handling of the herd accomplished only with what is available in the property; sanitary handling at basic level (e.g., separation of sick animals) and actions of control of endo- and ecto-parasites, usually answering to an endemic situation; reproductive handling based on natural covering.	There is no idea of productive chain. The connections and contacts between firms and organizations of the local institutional apparatus are incipient and sporadic.

(to be continued)

2—Advanced routine	Management of the property and zoo-technical and genealogical accompaniment of the herd through technical attendance and accomplishment of predictions of inputs consumption; concerns about environment.	Handling of feeding with voluminous and concentrated with the addition of basic mineral supplement; sanitary handling through the quarantine system for the recently-acquired animals and accomplishment of prophylaxes of the main ecto- and endo-parasitosis; covering station, with natural reproductive handling controlled to avoid exhaustion of breeders.	The connections and the contacts between the firms and the organizations of the institutional link intensify in amount, but they are still disjointed. Participation in local markets.
3—Basic innovative	Organizational management of property seeking the amplification of production scale, with development of new processes and products; development of systematic controls of technical attendance with genealogical and zoo-technical accompaniment of the herd and accomplishment of medium prediction of inputs consumption; environmental control of the property.	Development of forage and water resources for the preparation of the feeding in the own company through the adaptation of specific equipments with the addition of appropriate mineral supplement; automated systems for water supply and sanitary control for specific and frequent periods along the year; reproductive handling with the creation of genetically superior breeders and sows.	Articulations among the links of the productive chain, through systematic contacts between the firms and the other organizations of the influential institutional apparatus in the productive chain; active participations in technical meetings of class associations and in local events; effective participation in new markets niches.
4—Intermediate innovative	Organizational management and innovative development of agricultural system, processes and products through zoo-technical and genealogical individual controls of the productive and reproductive performance of the herd and of the resources and inputs of the property through specific software; increasing and original actions for environmental control.	Development of specific equipments and of a forage and water plan for the alimentary handling in agreement with a group of innovative criteria; sanitary and reproductive handling based on the development of new researches, bio-techniques, kits and specific methods for the prophylaxis and diagnosis of diseases, seeking the increment of the productivity of the herd.	Integration of the links in elapsing of the chain between the firms and other organizations of the institutional apparatus; active participations in technical meetings of class associations and in local and national events; increasing and conquests of new markets.
5—Advanced innovative	Organizational management and development of an agricultural system seeking radical improvements; development of individual controls of zoo-technical and genealogical electronic data of the performance of the herd with the implant of subcutaneous chips; development of good practices concerning the facilities engineering, seeking the well-being of the animals and innovative management of the environment.	Development of equipments and researches seeking new and advanced bio-techniques for production of victuals or appropriate alimentary supplement to specific needs of herds; for prevention and original diagnoses of diseases; and for the establishment of innovative reproductive handlings of multiple ovulations of females seeking genetic improvement of animals.	Integration among productive chains, partnerships and active and consolidated participation among suppliers, universities, R&D institutes and public and private organizations; increasing and conquests of new markets.
6—International border of innovation (Frontier Pushing)	Management of the enterprise with the development of an agricultural system based on complex, radical and open innovations for the technology transfer at global levels.	Development of complex original researches for the world, aimed to the nutritional, sanitary and reproductive handling and for the genetic improvement of the animals in R&D laboratories and/or associated to international centers.	Integration among global productive chains—places focused on new alternative businesses, complementary to goat husbandry.

Note. Source: Adapted from Lall (1987) and Figueiredo (2003) and based on field research.

The levels presented in Table 1 represent the complexity degrees reached by the execution of specific activities. So, the structure represents the build-up of the capacities studied in dynamic terms when involving

the examination of time (timing) and speed that the firms under study take to move (or not) through different types and levels of technological capacity. The descriptions of those types and levels are as follows:

(1) Basic routine—characterizes firms where the developed activities are not related to changes in the existent processes. At this level, the firm can execute a task, but it does not have the abilities to modify it. There is no organization around the productive chain. The contacts between firms and other organizations of the local institutional apparatus are incipient and sporadic;

(2) Advanced routine—characterized by the performance of routine activities that have a higher complexity degree. The existence of the productive chain is noticed, but the connections between firms and other organizations of the institutional apparatus in the context of the chain are disjointed;

(3) Basic innovative—characterizes firms where the routine activities are developed in agreement with increase improvements, through adaptations in equipment and/or in processes, products and in the organizational management. It is also evidenced that there is a larger control of the animal production activities, as well as a larger articulation and densification of the contextual connections among the firms and organizations of the influential institutional apparatus in the productive chain;

(4) Intermediate innovative—characterizes firms with good levels of innovative control of production and processes, which are accomplished in a planned way, integrating the different links between the firms and other organizations in the context of the productive chain, aiming at the development of innovations and impelling the movement in the sense of catching-up the production border and/or of an existent innovation;

(5) Advanced innovative—characterizes highly innovative activities developed in partnership with R&D laboratories through researches accomplished jointly and/or transferred, aiming at the development of innovations and impelling the movement in the sense of catching-up and/or overtaking the border of the production and/or of an existent innovation. The development of activities referred to at this level, in general, characterize the integration among productive chains with a focus on alternative businesses, but complementary to the goat husbandry;

(6) International technological border—characterizes activities developed by leader firms placed in the world technological border (Frontier Pushing). Integration is among global productive chains—places, partnerships and active participations among suppliers, universities, R&D institutes and local and global public and private organizations.

Table 1 presents the model of analysis of technological capacities adapted to small firms' participant in the goat husbandry productive chain. As well as in the original method, the columns represent the technological competences by function, and the lines represent the complexity degrees reached for the execution of specific activities (Lall, 1987).

The Underlying Learning Processes in the Accumulation of the Technological Capabilities

Starting from the data collected from the managers of the companies under study, an analysis was made in order to detect the mechanisms and present learning processes inherent to the external and internal acquisitions, socialization and knowledge code, as well as the relationship of these with the technological process and functions of each firm, as displayed in Table 2.

External knowledge acquisition. Concerning external knowledge acquisition mechanisms, flaws were noticed in the use of professional consultants. The contribution of this learning process could be observed in the functions of unit management, nutrition and health of the animals only in Firm D. In the other firms, the use of

veterinarians, zoo-technicians or consultants of the area, which are not of their own firms, is non-existent or is pointed to as cost generating and insufficient for the resolution of problems.

Table 2

Technological Functions for Learning Mechanisms and Processes

Learning mechanism and process		Firm and technological process and function			
		Firm A	Firm B	Firm C	Firm D
External acquisition	Professional consultants			Health	Health
	Experiences in other states				Unity management
	Interaction with suppliers	Nutrition		Unity management, nutrition, health, reproduction	Nutrition and health
	Interaction with customers	Unity management		Unity management, nutrition, health and reproduction	Nutrition and health
	Interaction with other breeders	Unity management, nutrition, health and reproduction	Nutrition	Unity management, nutrition, health and reproduction	Unity management, nutrition, health and reproduction
	Interaction with other organs	Unity management		Reproduction	Unity management, nutrition, health and reproduction
	Interaction with associations	Unity management		Nutrition and reproduction	
	Participation in events	Unity management, nutrition, health and reproduction		Health	
	Use of technical assistance	Unity management	Unity management, health and reproduction	Health and reproduction	Nutrition and health
	Search for information	Unity management, nutrition, health and reproduction			Unity management
Internal acquisition	Involvement in the installation of breeding facilities	Unity management			Unity management
	Routine operations of breeding facilities	Unity management, nutrition, health and reproduction	Unity management, nutrition, health and reproduction	Unity management, nutrition, health and reproduction	Unity management, nutrition, health and reproduction
	Improvements through projects of experimentation	Nutrition and reproduction		Nutrition and reproduction	Nutrition and reproduction
	Manipulation of creation processes	Reproduction		Reproduction	Reproduction
Socialization	Course-based Training				Reproduction
	Learning by doing	Unity management, nutrition, health and reproduction		Unity management, nutrition, health and reproduction	Unity management and health
	Sharing of knowledge	Unity management, nutrition, health and reproduction		Health and reproduction	

(to be continued)

Code	Manual notes	Unity management, health and reproduction		Unity management, nutrition, health and reproduction	Unity management, nutrition, health and reproduction
	Use of Microsoft Office software	Unity management, health and reproduction	Unity management, nutrition, health and reproduction		
	Use of specialized software	Unity management, nutrition, health and reproduction			Unity management, nutrition, health and reproduction

> I had two veterinarians and they made me suffer a loss, both of them… I had a goat that lowered and rose, lowered and rose. Then I took it to the veterinarian, he examined it, then he prescribed medicine and such. Then the goat did nothing, and nothing, and nothing… it is my champion's sister. I lost the goat because of him. (Field research)

The search for the experience of breeders in other states is made only by Firm D, whose manager constantly researches innovations in the structural aspect of breeders from São Paulo, as well as information related to the breeding practices in the Brazilian states of Rio Grande do Norte and Paraíba.

In regard to relationship networks in the context of the productive chain, it is noticed that there is a deficiency in firm-universities interactions. Even facing the recognition on the part of the managers of the importance of this interaction, the physical distance or even the indifference on the part of the academics hinders such a relationship that could be built and bring benefits for both parts.

"The great problem for us, as individual producers, is the difficulty, the kilometric distance that exists between the producer and the means… The university has to call the producers, to invite the producers, breeders" (Field research).

Besides, the interaction with government organs like EMBRAPA and EMATERCE are presented as incipient in the production of satisfactory results. The main causes of these flaws in the interaction with these and other organs would be related to a deficiency in the professionals' training and consultants, and mainly in the costs related to the consulting of these organs.

> What EMBRAPA wanted was to make a calculation and such, how many animals could be raised and if it had conditions to set up technical assistance and to develop experience. I had a reserved area in a laboratory for insemination and for transfer and Embrapa only agreed if I paid for everything. I had to pay for everything. This way it was difficult… And if it wouldn't work, who would be damaged? It couldn't work for me. (Field research)

On the other hand, the relationship in the context of the productive chain between their own breeders and associations is looked upon highly as something necessary and important. It is present and valued by all the managers. This relationship would be, therefore, responsible for improvements in the practices of administration of the business and animals breeding. Besides, the evolution of this relationship is observed by the appearance and the invigoration of concrete partnerships at all levels of the business, not just in what concerns information sharing, but in the development of projects and acquisition of equipments together.

> As individual producers, we don't have space anywhere. We, as an association, have different treatment… Association brings opportunities, you know, because they understand that the association has power.
> I want to buy an ultrasound… because of this group, of those three or four friends that are in the goat business, I believe that we should accomplish it together. We have plans of doing a partnership with personnel from Minas. We already talked about it for embryo transfer. (Field research)

The participation in events is valued and practiced by all the managers of the firms, equally in exhibition

and competition events, as well as participation in congresses or lectures of the sector. Such participation is pointed to as a source of information for new practices in the breeding facilities, especially related to the health of the animals. For instance, the manager of Firm C started to use quarantine norms in new animals: "At first, I didn't have orientation. But then, when we started to frequent exhibitions and had contact with breeders, then we had that idea. Then I started to adopt those norms" (Field research).

Regarding the search for information in magazines or specialized sites in the area, the manager of Firm D pointed out the importance of this kind of reading in the development of new processes and practices when affirming that "knowledge is a matter of feeling, it is through reading and animal breeding".

Internal knowledge acquisition. As internal knowledge acquisition mechanisms, involvement in new nursery facilities and the routine operations of them, are essential to the growth of the business. This was pointed out by the managers. Such mechanisms, especially the routine operations of the nurseries, are responsible for the development of new knowledge concerning the functions of unit administration, health, nutrition and reproduction.

Improvements are also used by experimentation processes. Such processes are related with the reproduction functions and nutrition of the animals.

> I changed the system over there. Before, they were all together, all in the same stall, collective. Now, for some time, about three months, I separated each animal. When they are fed with ration, I try to lock up the animals, in other words, they eat separately, individually. Then I can measure how much they are eating. (Field research)

Socialization and knowledge code. Concerning the socialization of knowledge, the manager of Firm D highlights the importance of the employee's attention on the veterinarian's work and his manager. This allows him to develop autonomy to accomplish the procedure by himself, as well as the importance of team work.

> First he learns… Whenever I make something I have somebody close to me and there is something that I already know and he learns… Who works on the team is versatile… Then, later we make another thing; the cattle holed the fence over there. Then inside the property he has to be versatile. If you leave a specific employee specifically in some job, he usually learns only that. When he doesn't come to work, you lose. So there must be team work. (Field research)

About investment in training, the manager of Firm C is willing to invest in training, but he still has not found the right employee. He complains this is because of a lack of interest and motivation on the part of the employees that have already worked with him:

> It is a lack of interest of them. See, I have been talking to some friends and we say this: I think I still didn't get to "hit the target", I didn't still get to "hit the target" of the business, I didn't get, but I am sure that guy will become a good professional, because I didn't still get a guy who likes that, I mean, who wanted to be there in the job because he likes it. Then my bigger difficulty is that, perhaps, because I didn't find a guy who had a right aptitude. They go because they need the job, some job, you know. Then I didn't get a guy who likes to breed, of living there,… certainly I have an interest of professionalizing that guy, his technical formation and everything. (Field research)

The manager of Firm C has already invested in an employee's professional formation, through courses addressed to the agriculture areas and livestock:

> I support… education not so much, but it is more in the matter of professional formation for agriculture and livestock… I always look if they have technical knowledge, especially because it's a form of valuing them… for instance, he took a course, specialized in an animal, about insemination, on handling, I try to make him to acquire the knowledge, preferably to apply it here. (Field research)

About the information coding process, the manager of Firm C uses Microsoft Office software to classify the data of the flock. The managers of Firms A and D, however, affirm that they have recently acquired specialized software for animal control.

The firm' articulations related to the processes in the context of the productive chain coincided with the beginning of 2007 on the class association activities—CAPRILEICE, denoting that they developed their institutional articulations in a strategically planned way, in the attempt of integrating different links in the context of the productive chain, aiming at the increment of innovations.

Final Considerations

The study presented here is based on empiric evidences through extensive field work. This method generated a considerable amount of data. These are fundamental for the characterization of technological capacities and analysis of underlying learning processes in the accumulation of the technological capabilities in small firms which are participants in the goat husbandry productive chain.

The analyses were completed with information supplied by the organization of secondary data and through the collection of primary data by a group composed of 12 specialists of the sector and the completion of deep interviews with those specialists and the managers of the four firms under study. The importance of learning mechanisms in the innovation process and development of the technological capabilities is evidenced. Table 3 presents the levels of each one of these technological functions observed in the four firms of the goat husbandry productive chain.

Table 3

Levels of Technological Capabilities in the Studied Firms

Goat husbandry firm	Activity and technological process and function		
	Productive unit management	Nutrition, health and reproduction	Articulation in the context of the productive chain
Firm A	Intermediate innovative (4)	Basic (3), intermediate innovative (4) and basic innovative (3)	Between basic innovative (3) and intermediate innovative (4)
Firm B	Advanced routine (2)	Basic innovative (3), advanced routine (2) and advanced routine (2)	Between basic innovative (3) and intermediate innovative (4)
Firm C	Advanced routine (2)	Intermediate (4), basic innovative (3) and advanced routine (2)	Between basic innovative (3) and intermediate innovative (4)
Firm D	Intermediate innovative (4)	Intermediate (4), basic innovative (3) and basic innovative (3)	Between basic innovative (3) and intermediate innovative (4)

It is observed in the analyzed firms' activities and technological functions, which activities, related to nutrition, possess a more developed level of technological capacity compared to the other functions; that is, which one is more beneficial to the current learning mechanisms used. The activities related to reproduction still lack improvement when compared to the other learning mechanisms observed. These last ones must be worked on from a point to generate and develop more advanced technological processes in this aspect.

It is observed during the analyzed timescale, instabilities in the strategic management of the firms' knowledge when they limit the build-up of technological capacities. This limitation is related to the firms' low capacities with respect to conversion of knowledge obtained through external sources, as well as, the firms' difficulties to integrate the different knowledge bases acquired with those already in existence, thus enabling the dynamic co-evolution of the learning processes. On the other hand, those processes highlighted the role of the external and open sources between the company and its context, allowing for easier development and

circulation of innovations.

Finally, due to the limitations of the research method used, subsequent studies are suggested to approach the same relationship in other empiric fields, especially in areas in which this activity is more developed. Furthermore, it would be possible to base on such understanding about these relationships and to achieve new practices that make it possible for the development of the productive segment, consequently aiding in the formulation of public policies addressed to the needs of the sector.

This study contributed to expand and clarify the understanding of the implications on underlying learning processes in the dynamics of the accumulation of technological capabilities in participating firms of the dairy goat husbandry productive chain in the state of Ceará, Brazil. In spite of certain negative and pessimistic generalizations related to the technological development of small firms, the evidences of this study have shown a promising field.

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One Hospital's Response to Cost Containment Pressure
in Patient Laboratory Services

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The Health Care and Education Affordability Reconciliation Act of 2010 (H.R. 4872) is expected to have a significant effect on health care for individuals and hospitals. One intended effect of H.R. 4872 is in its impact on cost containment, particularly for hospital services. One area of hospital services that reflect high patient demand is laboratory services. Some hospitals have brought lab work inside the hospital and look for ways to reduce costs while maintaining high quality. In this study, the authors were asked by a regional U.S. hospital to help in updating the computation of reference intervals for its specific patient population related to routine lab tests. This study performed the initial step toward determining usable reference intervals for the hospital.

Keywords: H.R. 4872, cost containment, lab tests, reference intervals

Recently, President Obama signed law H.R. 4872 (the Health Care and Education Affordability Reconciliation Act of 2010). This legislation is expected to have a significant effect on health care for ordinary American citizens. Under this health care reform, typical American citizens would be able to keep the insurance they have, pay less for preventative care, and no longer have to worry about being denied for a claim based on pre-existing conditions or see limits on their insurance coverage. Additionally, the Bill includes several provisions related to the Medicare program. For those seniors enrolled in Medicare Part D for their prescription drug coverage, it closes the "donut hole" within the decade. In addition, H.R. 4872 provides free preventative care under Medicare that will keep seniors healthier and longer (U.S. Public Law, 2010). Subsequent to its enactment, H.R. 4872 has come under attack both in the U.S. Senate and the U.S. Federal Courts. These efforts will play out over the next several years with their outcome uncertain.

One significant effect of H.R. 4872 in the near term, however, is in its impact on cost containment, particularly for hospitals. Beginning in 2010, H.R. 4872 would reduce annual market basket updates for inpatient hospital Medicare providers, and adjust payments to force productivity improvements on these hospitals. In subsequent years, the Bill would limit Medicare payments to qualifying hospitals in counties with the lowest quartile Medicare spending for 2011 and 2012. Furthermore, the Bill would reduce Medicare payments that would otherwise be made to hospitals by specified percentages to account for excess

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(preventable) hospital readmissions (Kaiser Family Foundation, 2010). One thing that appears certain is that in future years hospitals are going to receive less and less Medicare reimbursement funds for the patient services they provide.

One area of hospital services that reflect high patient demand is laboratory services. Virtually all hospital inpatients require laboratory blood work daily, and a number of hospitals outsource this routine blood work to off-site privately held labs. One of the largest of these private labs is Laboratory Corporation of America[®] Holdings (LabCorp[®]), which has testing sites worldwide. LabCorp's earnings grew in the second quarter of 2010 by 4.2% compared to the first quarter, and net earnings for the second quarter were $153.7 million on revenues of $1,194 million (Lavender, 2010). In fact recent profits have been very good, enabling LabCorp directors to authorize a new stock repurchase program under which LabCorp may purchase up to an additional aggregate of $250 million of its common stock (Anonymous, 2010).

Given the high demand and lucrative nature of routine laboratory tests, some hospitals have brought lab work inside the hospital and look for ways to reduce costs while maintaining high quality. Clinical laboratory tests are very important because 80% of physician's medical decisions are based on laboratory reports (Katayev, Balciza, & Seccombe, 2010). These tests include standard pathology blood serum tests based on reference intervals. For example, for an LDL (low-density lipoprotein) cholesterol test the reference interval for a healthy patient is between 70 and 160 mg/dl (MayoClinic.com, 2010). The result of a clinical test has no value unless the appropriate reference interval is available for its interpretation.

Reference intervals are available for the population in general, but reference intervals should be calculated for the population being tested. According to the Clinical and Laboratory Standards Institute in its C28-A2 standard document on reference intervals, the importance of validating reference intervals is emphasized. Additionally, research suggests that reference intervals used in laboratory tests should be updated periodically (Paxton, 2009).

The focus of this study is a medium-sized hospital in the southwestern U.S. (Hospital) which seeks to refine and upgrade its laboratory services unit to the highest levels of quality. The hospital has turned to the College of Business in a regional private university (Business School) for statistical help in updating the computation of reference intervals for its specific patient population. These updated reference intervals will be used to compare a patient's results for a standard lab test.

Overview

Reference intervals for standard pathology blood serum tests, such as cholesterol, potassium, etc., are important to a physician's analysis of a patient's health. While reference intervals exist for the world population as a whole, the medical decision process greatly improves using values appropriate to the patient's population.

A reference interval suggests a numeric range for a given test in which results from healthy individuals should reside. World-wide reference intervals are not altogether applicable for a population segment due to variations in race, diet, living conditions and other lifestyle factors. Each regional hospital is responsible for the computation of reference intervals for their specific patient population.

The authors were asked by the hospital to determine reference intervals for standard pathology tests. Reference intervals computed previously at this hospital were considered out-of-date and were, potentially, not computed from a population sample which fully represented the local community. While the hospital maintained a pathology laboratory information system, the ability of staff to analyze data from a large

population sample was outside their current capabilities.

The goal of this study was to import, filter and analyze laboratory test results, obtaining representative reference intervals for the tests specified. Data filtering of test samples was required to separate healthy from unhealthy patients, leaving only samples from the healthy patient population. This step insures the calculated reference intervals represent the expected range of a healthy individual. Study output includes not only first-order reference intervals, but also a fully cleansed data set, enabling the hospital to perform additional analysis.

Background and Literature Review

As a diagnostic method analytical chemistry using blood serum became widely available after World War II. Procedures and machines allowed for large-scale processing to measure multiple substances in a single test cycle (Harris & Boyd, 1995). As laboratory testing became available for mass use, the need for standardized methodologies of test interpretation became evident. Wooten, King, and Smith (1951) first proposed methods with probability distributions using Gaussian statistics, comparing a patient's sample against a measurement distribution from supposed healthy individuals. Gaussian statistics are considered important for reference interval computation because normal statistics allow mathematical expressions to correlate distances between subgroups of a distribution (Lahti et al., 2004). The concept of a normal range for each measurement began to take shape, although normality differed between subgroups of individuals (Wooten, 1962). Individual laboratories were found to have had differing normal ranges for their tested population (Belk & Sunderman, 1947).

The fundamental question of what normality actually represented was at issue and debated within the literature (Alstrom, 1981; Murphy & Abbey, 1967). The term normal carried an ambiguity due to its varied meanings and lent itself to different patient interpretations (Sunderman, 1975). The International Federation of Clinic Chemistry (IFCC) adopted official terminology, replacing the term normal with reference to describe a value spectrum for a given analytic test result (Gräsbec et al., 1979). Other important terms also were defined by the IFCC for clinical use including reference individuals as those whose samples went into the determination of reference intervals.

Determining reference intervals must begin with samples from reference patients. The goal is to take samples from a representative population of healthy individuals, assuming the population is generally healthy. The reference intervals for a diseased population subset, such as those who are HIV positive, while clinically valuable, are most useful as compared to the healthy population. The definition of "healthy" then becomes a debate as encountered with the term normal.

For simplicity, certain laboratories have used their own employees as reference individuals (Vestergaard et al., 1999) as detailed medical history is readily available along with a familiarity of their lifestyles. Determining the health of unknown individuals is both costly and time consuming, with the additional possibility of undisclosed unhealthy activity. The Clinical and Laboratory Standards Institute (CLSI) has set a minimum of 120 healthy individuals for determining reference ranges using non-parametric measures (Wayne, 1995). Using non-parametric statistics removes the requirement of a Gaussian distribution in the sample data, providing a more robust analytical method. Reference intervals are most often determined using percentile values of the substance distribution from a healthy population. Traditionally this has been done using the bottom 2.5% and the upper 97.5% percentile values to define the reference intervals (Horn & Pesce, 2005).

Typical operations at modern clinical laboratories have thousands of patient test samples in digitized form,

held in laboratory information systems. Some clinicians have argued that these samples could be used for the determination of reference intervals through removal of unhealthy patient data (Pryce, 1960; Hoffman, 1963; Hoffman, 1971). The IFCC and CLSI have suggested techniques to remove patients with certain outlying sample values which correspond to known disease conditions (Wayne, 1995). For example, a Creatinin value greater than two indicates the possibility of kidney problems, suggesting all tests for this patient should be removed from analysis. Other studies have employed correlation of tests within a population to screen for aberrant values within individual samples (Enzo, Roberto, Silvio, & Carlo, 2005). The set of conditions employed by each laboratory must take into consideration their population and unique environment.

Another problem plaguing the science of reference intervals was the inability to share results across laboratories, even with similar sample populations. While each laboratory might be internally consistent, adhering to strict quality control measures, both the reagents and procedures used in the testing process often differed. The United States Congress enacted the Clinical Laboratory Improvement Act of 1967 and an Amendment Act of 1998 to remove the use of so-called "home brew" reagents in clinical laboratory testing (Centers for Medicare and Medicaid Services, 2006). Even so, there still exist differences between results from differing laboratories, requiring each to verify reference ranges for their population (College of American Pathologists, 2004).

A primer on the current state of reference interval science was compiled by Horn and Pesce (2005). Their compilation continually reinforced a fundamental tenet of statistical processing using real-world data; unless outlying data values are known to be in error due to recording or measurement, they should remain in the analysis instead of being removed. This simple rule ensures the end product is not the result of premature data cleansing, but fully represents the sample population. The data processing and statistical analysis employed for this study was held to this standard.

The Study Process

The purpose of this study was the development of initial confidence limits for specific laboratory tests as reference intervals. While final reference determination was outside the scope of this study, significant work was achieved toward its end. At the completion of this study, the hospital expected to receive initial analysis results from data cleansed by their defined rule-base for healthy patients over a six-month period and the cleansed data set for subsequent work.

The first step in the process was to meet with hospital personnel responsible for the generation of data and maintenance of the laboratory system. This was to include the resident physicians responsible for the pathology lab, physician interns studying to become licensed pathologists, the laboratory technicians who performed the in-lab testing, and the employees responsible for data collection and processing. These individuals would provide the required background material for the study along with the domain knowledge to extract and filter the data.

The rules for filtering tests to obtain only healthy patients were to be fully defined by hospital personnel in the first phase. They were to be deterministic and clear, requiring no manual intervention for data cleansing. A first-order rule would filter samples based upon validity rules for data. For example, a test value must be numeric or the doctor field must not be blank. A second-order rule would remove data samples based upon the numeric values as advised by the medical staff, for example, remove all patient data where a cholesterol test was greater than 200. Second-order rules are of more concern because they perform outlier rejection at an early stage. A review of second-order rules was deemed very important to the validity and acceptability of the study results. For

use, the rules were to be encoded into either scripts or higher-order software to achieve a fully cleansed data set.

A substance for analysis in a pathology laboratory is termed an analyte. Reference intervals for the analytes in Table 1 are of particular interest to the Hospital and are provided with their shortened pneumonic code used in the lab. Working definitions and purpose also are given as provided by Internet Primate Aging System in 2007 (American Association for Clinical Chemistry, 2001-2007).

Table 1

Analytes of Study Interest

Analyte	Pneumonic	Definition	Usefulness
Albumin	ALB	A protein manufactured by the liver to maintain osmotic pressure	Hepatic and liver disorders
Alkaline Phosphatase	ALKP	An enzyme which triggers specific chemical reactions	Hepatobiliary and bone disorders
Blood Urea Nitrogen	BUN	A metabolic by-product (in the liver) from the breakdown of blood, muscle and protein	Renal function
Calcium	CA	Maintains healthy bones, teeth and muscle contraction	Hypercalcemia, renal disease
Chloride	CL	Maintains blood PH and transport of CO_2	Increased-acidosis; decreased-edema
Creatinin	CREA	Protein produced by muscle and release into the blood	Renal function
Potassium	K	Regulates heartbeat and muscle function	Electrolytic balance and renal function
Sodium	NA	Controls water retention and proper nerve and cell function	Blood pressure and water balance
Aspartate Aminotransferase	SGOT	An enzyme present in hepatocytes and heart cells	Released into the bloodstream as the result of liver damage
Alanine Aminotransferase	SGPT	An enzyme that is found primarily in the liver	Released into the bloodstream as the result of liver damage
Total Bilirubin	TBIL	A pigment that is largely derived from the breakdown of hemoglobin	Liver function
Total Protein	TP	Total amount of protein in the body	Reflects how well the liver is producing proteins
Cholesterol	CHOL	Used to form cell membranes and other tissues	Lipid metabolism
Triglycerides	TRIG	A fatty substance (lipid) found in the bloodstream	Lipid metabolism
Iron	FER	An atom required to form hemoglobin in red blood cells	Increased-dehydration; decreased-anemia
Total Iron Binding Capacity	TIBC	Measures the amount of iron that can be carried through blood	Monitor anemia
Lactate Dehydrogenase	LDH	A enzyme present in all cells	Cell damage
Lipase	LIP	Enzymes produced by the pancreas to help digestion	Pancreatic function
Amalyase	AMYL	Enzymes produced by the pancreas to help digestion	Pancreatic function
Magnesium	MG	Element vital to energy production	Help determine the cause of abnormal calcium and/or potassium levels

While the authors had no practical experience in clinical chemistry, this provided an advantage by looking at the data without a preconceived bias toward an expected result. The medical inter-relationships between analytes were unknown to the authors and therefore could be explored strictly through statistical processes. However, because the study relied upon data from a healthy population, medical knowledge of the analytes was important for data screening. The chosen analysis approach was for the authors to implement the screening

algorithms as prescribed by hospital clinicians and then to use statistical methods to research the data in depth. Interim results were reviewed on a periodic basis by hospital personnel for medical significance, providing course correction as needed.

Once the data were delivered for analysis by hospital personnel, the next step involved creating software to reformat the data into a form usable for analysis. Because the hospital performs approximately 20,000 test sets, or panels, per month, manual filtering of data would be time-consuming and subject to error. The study was to use six months of raw laboratory tests to develop the reference intervals. Through continuing interviews with hospital personnel, the rule-base was refined until agreement on the final data set was reached.

The filtered data was then fed directly into the statistical analysis phase. Simple statistical values were computed on each analyte without concern as to interactions between values. From these, reference intervals were computed for each analyte over the entire sample as well as selected subsets of the independent data that was age, sex, and so on. These results then were presented to hospital personnel for review and comment. The outcome of this phase would identify potential problems as well as direct more in-depth analysis.

Data Receipt and Analysis

Issues of patient privacy, as pertains to Health Insurance Portability and Accountability Act (HIPAA) passed by the U.S. Congress, severely limits the dissemination of patient information, with stiff penalties for violation. While the actual patient name or other identifying information is not required for the study, the database in which this information resides is directly linked to private data. Hospital personnel removed any personal information from the extracted data given to the authors.

The hospital was prepared to offer a completely filtered data set for our analysis use. This pre-cleansed data set would not require additional removal of data based upon criterion needed to ensure only a healthy patient population. It was the view of the authors, however, that it would be better from a procedural standpoint to receive all the data and then perform filtering using hospital personnel direction. The utility in this method:

(1) Gives the authors experience with the full range of the data values recorded by the laboratory system;

(2) Does not bias the statistical processing by eliminating outliers too early in the process;

(3) Allows for simple post-comparison of reference sets between healthy and potentially sick patient.

The hospital provided the authors with a machine readable version of the laboratory samples, and sanitized of personal patient information. As directed by hospital doctors, the duration of the extract must cover approximately six months to fully enforce the heuristics needed to filter the data for healthy patients only.

Receipt of Raw Data

The extracted data, covering tests performed over a six-month period, was delivered to the authors. The overall record count in the raw data was 112,824 individual samples. Filtering rules set by hospital personnel were used to remove unhealthy individuals, based upon expert medical opinion. Of the original 112,284 records received, 100,985 records were removed for the reasons outlined above with 11,839 records remaining for analysis. Table 2 gives the count for each sample removal reason after data filtering.

The set of records excluded by the rule specified was reviewed with hospital personnel by e-mail, telephone and face-to-face meetings. The final list of filter data was agreed upon as suitable for initial analysis.

Statistical Analysis

To meet the needs of this analysis, the authors used the SPSS statistical package. To illustrate one example

of how a reference interval was developed, the cholesterol reference interval was discussed.

Table 2

Data Removal Reasons by Count

Count	Reason for removal	Count	Reason for removal
30526	Patient admitted to hospital/assigned a bed	457	Creatinin value > 2
12067	Lipid panel without comp panel	365	Glucose value < 70
11136	TRIG value > 200	342	TBIL value > 2
9194	Doctor is in the exclusion list	299	Other SGPT value > 58
8403	Cholesterol value > 200	170	ALKP value > 230
5508	Multiple tests	133	SGOT value > 80
5054	Cholesterol/HDL (high-density lipoprotein) value > 5.0	130	Patient admitted to hospital/assigned a room
2918	Patient age is less than 18	104	Other glucose value < 70
2682	Other sample has a bed	92	Other creatinin value > 2
2034	Glucose value > 140	63	Other TBIL value > 2
1740	No doctor assigned to test	56	Albumin value < 2.5
1336	Record unique identifier begins with R	36	Doctor begins with R
1283	SGPT value > 58	33	Other ALKP value > 230
1243	Other sample has doctor on the exclusion list	27	Other SGOT value > 80
1235	Other TRIG value > 200	17	Sex is not marked M or F
1005	Other cholesterol value > 200	11	Other sample has a room
741	Other cholesterol/HDL value > 5.0	9	Other albumin value < 2.5
536	Other glucose value > 140		

After initial filtering and statistical analysis, it was found that the cholesterol values exhibited a non-normal distribution. Due to the cholesterol filtering cutoff rule at 200, the distribution showed a distinct tendency toward the upper values, even though the samples were from supposed healthy people. Because lipid panels, which contain the cholesterol analyte, are often taken separately, a good portion of the detailed filtering rules will not fire as they are associated with the comprehensive panel tests. Using the assumption that people who might be subject to high cholesterol may be tested often only with a lipid panel, a new filtering mechanism was prescribed. Lipid panels only will be accepted when they are for patients having a comprehensive panel which passes all other health tests. This filter step alone removed over 12,000 lipid panels from the final data set. However, the reduction in lipid panels still yielded over 4,000 samples, with a distribution more expected for a healthy population.

While the lipid-comp screening provides a more normal distribution for cholesterol, the prescreened cut-off value of 200 continues to be problematic when determining reference intervals. Figure 1 implies the following conclusions for cholesterol in this sample population:

(1) The cut-off value at 200 is insufficiently small and effects the proper computation of a reference interval;

(2) There are other screening criteria which should be used to remove additional samples to fully represent a healthy population;

(3) The hospital's sample population is abnormally high in cholesterol.

Current medical understanding limits the upper value for cholesterol at 200 mg/dl and therefore the cutoff is accepted. Further research by the hospital should be undertaken to determine how this might be handled in future analysis.
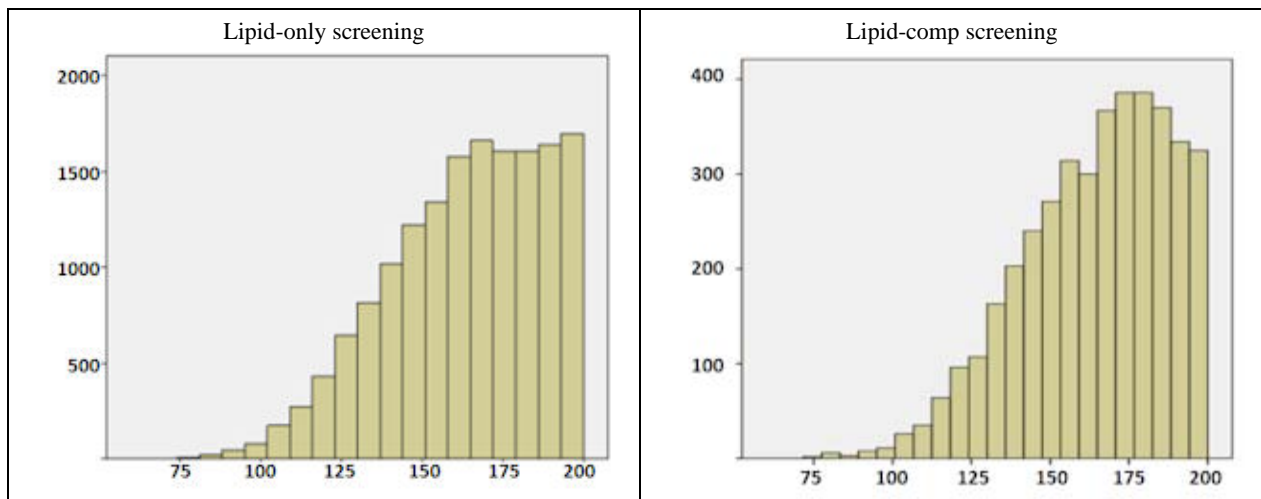
Figure 1. Screening comparisons for lipid panel distributions.

Table 3

Current and Proposed Analyte Reference Intervals

Analyte	Sample count	Unit	Current	Proposed	Difference	
ALB	10,107	g/dl	3.4-5.0	3.5-5.0	+0.1	0.0
ALKP	10,107	IU/L	30-115	42-143	+12	+28
BUN	10,107	mg/dl	6-22	6-30	0	8
CA	10,107	mg/dl	8.4-10.3	8.5-10.2	+0.1	-0.1
CL	10,108	mEq/L	96-106	96-108	0	+2
CO_2	10,108	mEq/L	22-33	23-34	+1	+1
CREA	10,016	mg/dl	0.4-1.4	0.5-1.5	+0.1	+0.1
Glucose	10,107	mg/dl	< 140	75-132	NA	-8
K	10,107	mEq/L	3.5-5.3	3.4-5.3	0.1	0
NA	10,108	mEq/L	136-145	133-144	-3	-1
SGOT	10,107	IU/L	0-40	0-43	0	+3
SGPT	10,107	IU/L	0-29	0-48	0	+19
TBIL	10,017	mg/dl	0.2-1.0	0.4-1.4	+0.2	+0.4
TP	10,108	g/dl	6.0-8.0	6.2-8.1	+0.2	+0.1
CHOL	4,017	mg/dl	< 200	113-199	NA	-1 †
HDL	4,108	mg/dl	< 40	31-75	NA	+35 †
LDL	4,108	mg/dl	< 200	52-131	NA	-69 †
TRIG	4,107	mg/dl	< 200	38-189	NA	-11
FER	742	ng/ml	20-300	4-579	-16	+279
Iron	621	mcg/dl	39-150	17-199	-22	+49
TIBC	624	mcg/dl	241-421	221-525	-22	+104
LDH	115[*]	IU/L	60-200	116-234	+54	+34
LIP	805	U/dl	166-292	131-374	-35	+82
AMYL	563	IU/L	28-100	22-117	-6	+17
MG	380	mg/dl	1.8-2.9	1.6-2.3	-0.2	-0.6

Notes. † Subject to issues with cholesterol screening. [*] Below acceptable limits for the number of samples.

Table 3 summarizes the reference limits for each analyte in this study. For simplicity, non-parametric order statistics were used to compute the reference limits of 2.5% and 97.5% of the sample population. The table provides the number of samples used in the statistical calculations, the analyte unit of measure, the current reference intervals, the proposed reference intervals and the differences between current and proposed intervals.

Conclusions

As discussed earlier, the hospital has turned to the College of Business in a regional private university (Business School) for statistical help in updating the computation of reference intervals for its specific patient population. These updated reference intervals will be used to compare a patient's results for a standard lab test.

This study performed the initial step toward determining usable reference intervals for the hospital. Due to the volume of study data, the current rule set excluded large numbers of samples while still having sufficient number for reference computation. These filtering rules, however, might lead to unforeseen bias on the resultant data set and should be analyzed carefully, checking on which patients were actually excluded and which included. Other higher-order techniques, utilizing analyte-to-analyte comparison, might also prove useful.

Utilization of the study's results by clinicians will require detailed analysis. For example, the study's results regarding cholesterol are intriguing to the hospital's staff. Despite of the fact that national current medical understanding limits the upper value for cholesterol at 200 mg/dl, the hospital's results reflects higher cholesterol values in their regional population. This finding suggests that the regional population may support a higher upper value for cholesterol in subsequent tests. Further research by the hospital should be undertaken to determine how this might be handled in future analysis. For example, grouping population subsets by age and sex should match existing medical research and experience. Similarly, the predictive power of the study can be quickly tested using samples from future panels taken over the next year. Developing a structure by which this can be quickly accomplished would be valuable to the hospital.

Future Research

Several avenues for continued research became evident from our initial investigation and will be considered by the hospital and the authors:

(1) The mean of the cholesterol distribution from the entire data set is 187 with a standard deviation of 44. The filtering value of 200 appears to be well below the distribution and should be examined carefully for subsequent increase;

(2) Subdivision by the independent variables of sex, age and race should be performed on each analyte, using the Z-test to determine significance of each component;

(3) Higher-order filtering, using the Spearman Rank Correlation, should be undertaken to further refine the cleansed data set;

(4) Conversion of analyte sample values using logarithmic or exponential transformations should be explored to extend the analysis using different statistical measures.

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