

# **DataMOCCA**

## **DATA MOdel for Call Center Analysis**

### **Volume 5.1**

### **Skills-Based- Routing in US Bank**

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# DataMOCCA

## DATA Model for Call Center Analysis

The DataMOCCA Project is an initiative of researchers from the Technion—Israel Institute of Technology and The Wharton School—University of Pennsylvania. The mission of the project is to collect, pre-process, organize and analyze data from Telephone Call/Contact Centers. The raw data obtained are call-by-call records of at least one year's duration from active Call Centers. Among the goals of the project are the development and distribution of Call Center databases, using a uniform schema. The data repository created, together with software tools, will be accessible through the world-wide-web and provide a resource for researchers and teachers of Service Engineering, Science and Management.

### List of Documents

Volume	Title	Revision Date
1	Model Description and Introduction to User Interface	July 29, 2006
2	Summary Tables Variable Definitions	August, 2006
3.1	SEESat Guide I – Beginning User	to be completed
3.2	SEESat Guide II – Advanced User	July, 2008
3.3	SEESat Guide III – Data Extraction Facility	to be completed
4.1	The Call Center of a "US Bank"	November 2, 2006
4.2	The Call Center of "IL Telecom"	November 2, 2006
4.3	Empirical Analysis of a Call Center in an Israeli Commercial Company	July, 2009
4.4	Empirical Analysis of a Call Center	August, 2009
5.1	Skills-Based-Routing in a US Bank	February, 2008
6.1	Empirical Analysis of Little's law using Data from the Call Center of US Bank	May, 2010
6.2	Implementing the Offered-Load in SEESat	May, 2011

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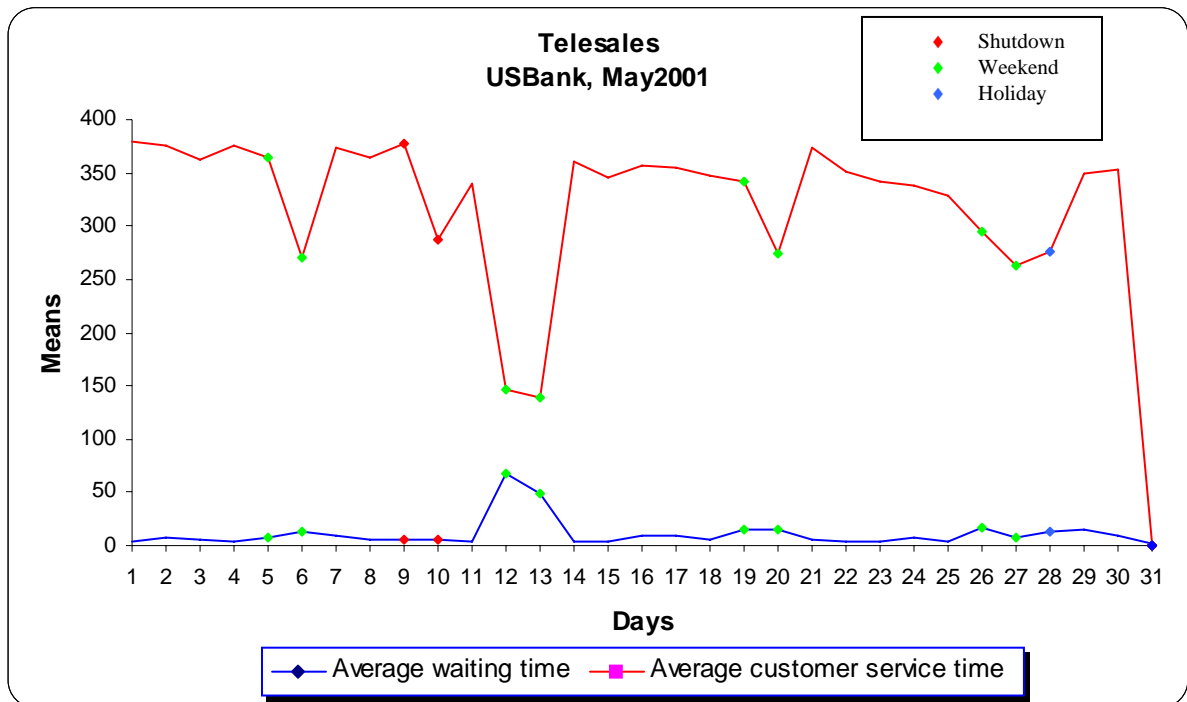
## Sample Analysis of Peak Waiting Time

Here we demonstrate how skills-groups<sup>1</sup> and their main-service<sup>2</sup> can be used to identify operational roots of congestion that cause deterioration in service levels. We envision such applications as supporting daily root-cause analysis, which is common in call centers.

The following scenario is described via DataMocca graphs (see the five figures below):

- A monthly picture identifies a peak in the average waiting time of Telesales calls and a bottom-level in the average customer service time, on Saturday and Sunday, May 12-13, 2001.
- Focusing on these days, we see that almost all calls between 8:00-16:00 actually waited for service.
- In addition we discover that, on this weekend, the number of telesales calls was smaller than normal, and most Telesales calls arrived after 16:00.
- We see that, on this weekend, there were no agents whose main-service is Telesales.
- Finally, Retail agents<sup>3</sup> served some Telesales calls on this weekend; but on Sunday 13, between 8:00-16:00, no agents attended to Telesales calls. Additionally, we see that on Sunday at 20:00, an EBO agent gave one Telesales service.

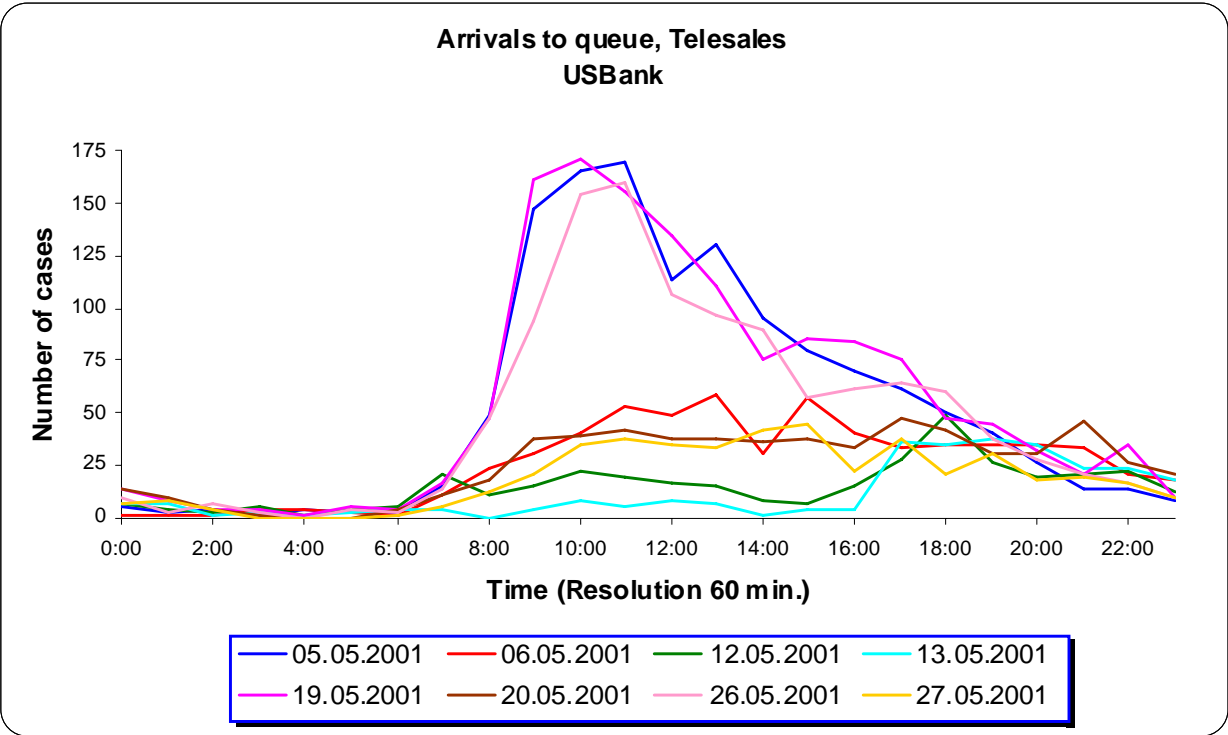
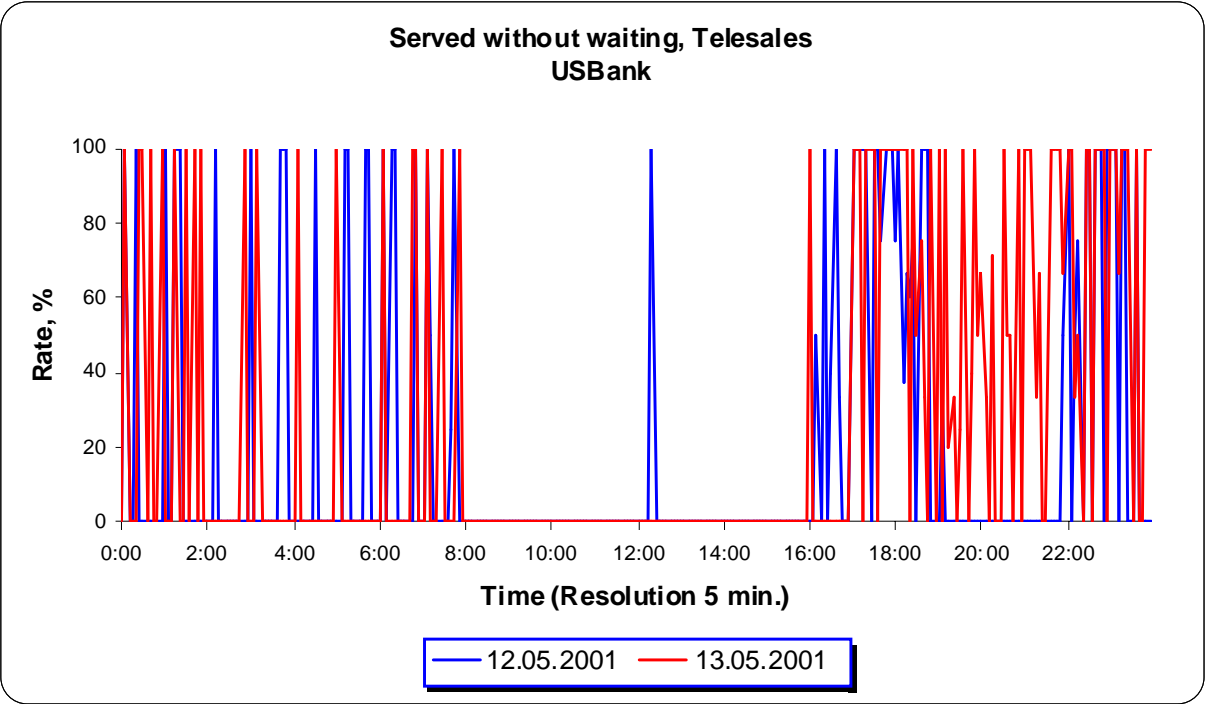
It is now left for the managers of Telesales to confront these findings: find out why there were no Telesales agents in the call center on this weekend, why the number of Telesales calls was smaller than in other weekends and why, when Retail agents served Telesales calls, their Average service time was shorter than when Telesales agents served Telesales calls.

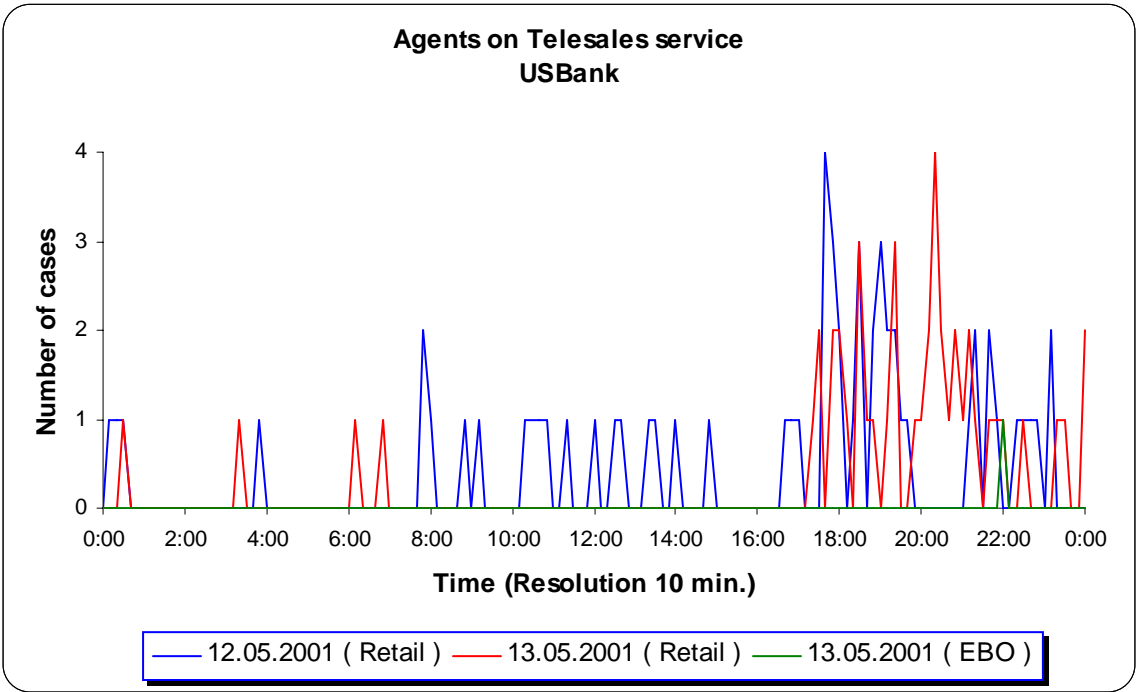
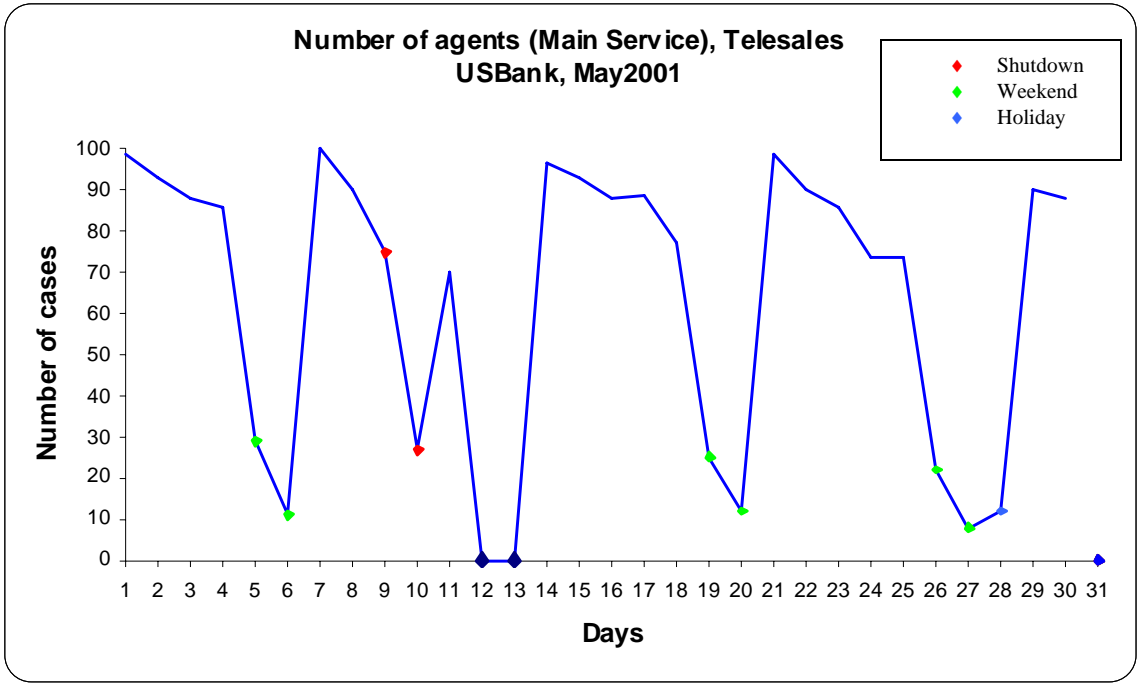


<sup>1</sup>Skill-group is defined to be a group of agents that have the same skill-set to serve the different service types.

<sup>2</sup>Main-service is defined to be the most important service type that a skill-group serves. More specifically, the main-service is defined according to the percentage of the agent calls from each service type and the percentage of the service type calls in each agent group (The trade off between these two factors is illustrated via some examples on page 12).

<sup>3</sup>Some times, we write some service type to denote "agents whose main-service is this service type". (For example, "Retail agents" means "agents whose main-service is Retail").

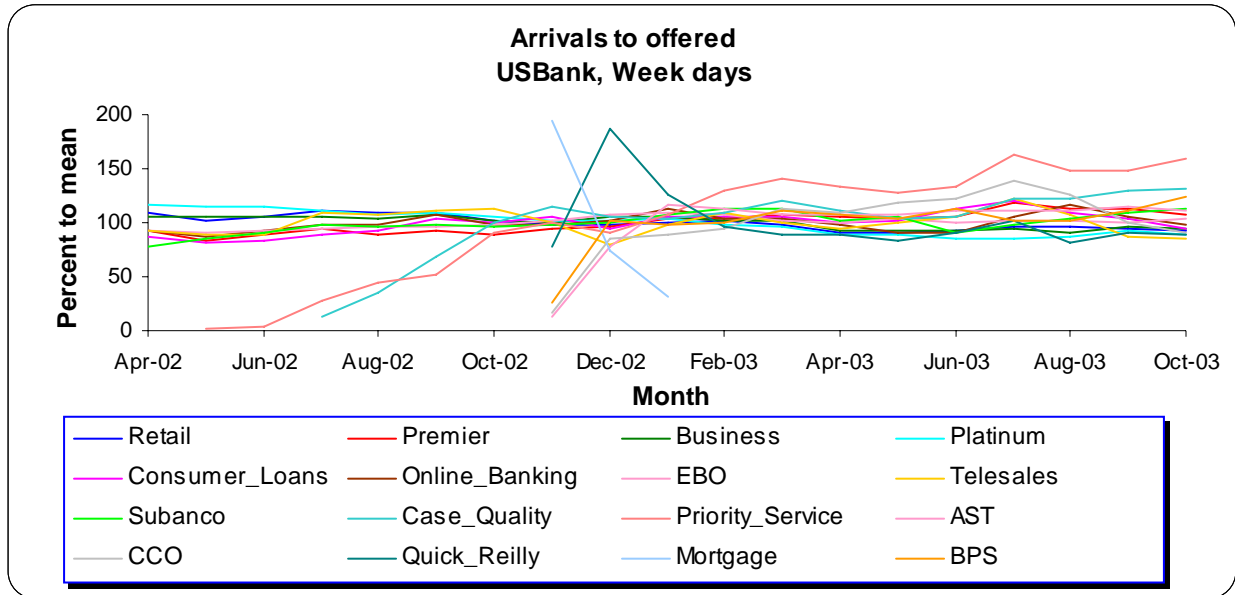




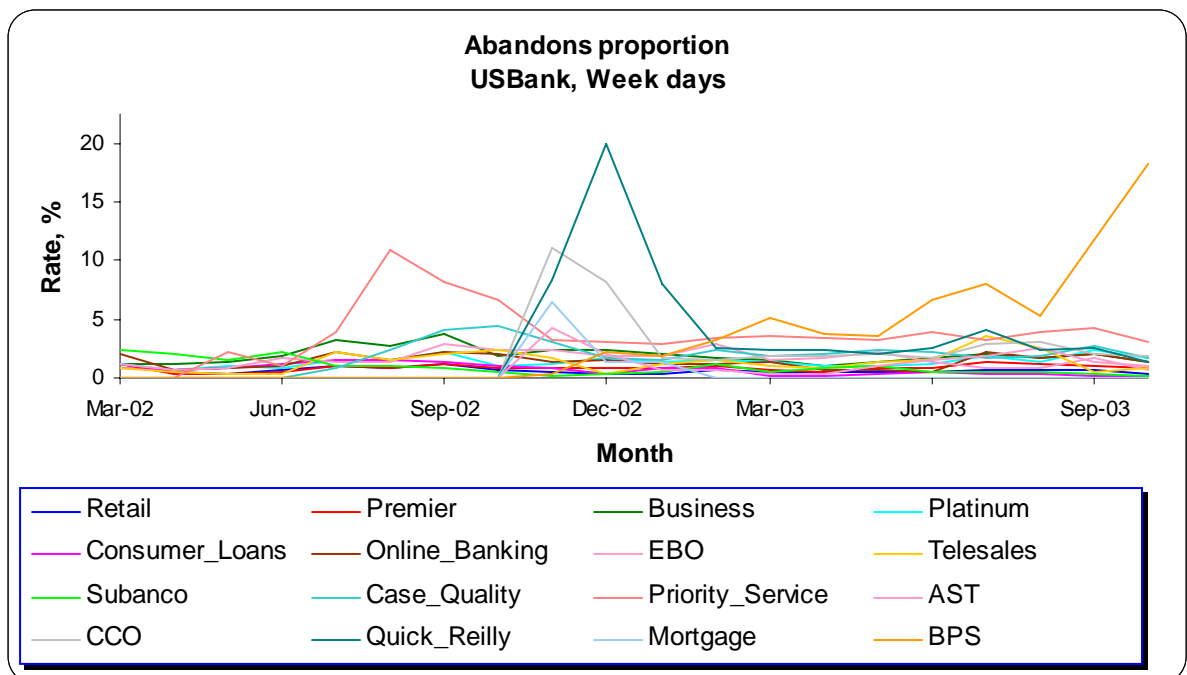
## Newly-Formed Agents Groups

In July 2002 and November 2002, the call center opened new skills-groups for new service types. We analyze how these groups initialized their work, and how the other services were affected.

In the following figure we note that “Priority Service” opened in May 2002 and “Case Quality” opened in July 2002. In addition, on November 2002 services “CCO”, “AST”, “Mortgage”, “Quick\_Reilly” and “BPS” were opened, and on January 2003 “Mortgage” service was closed.

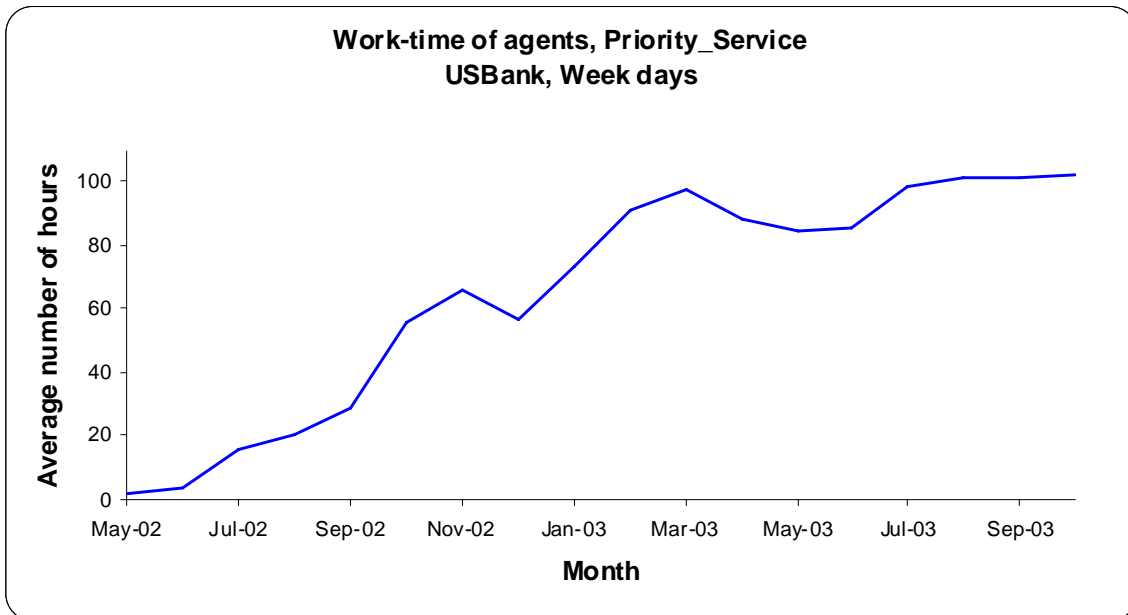
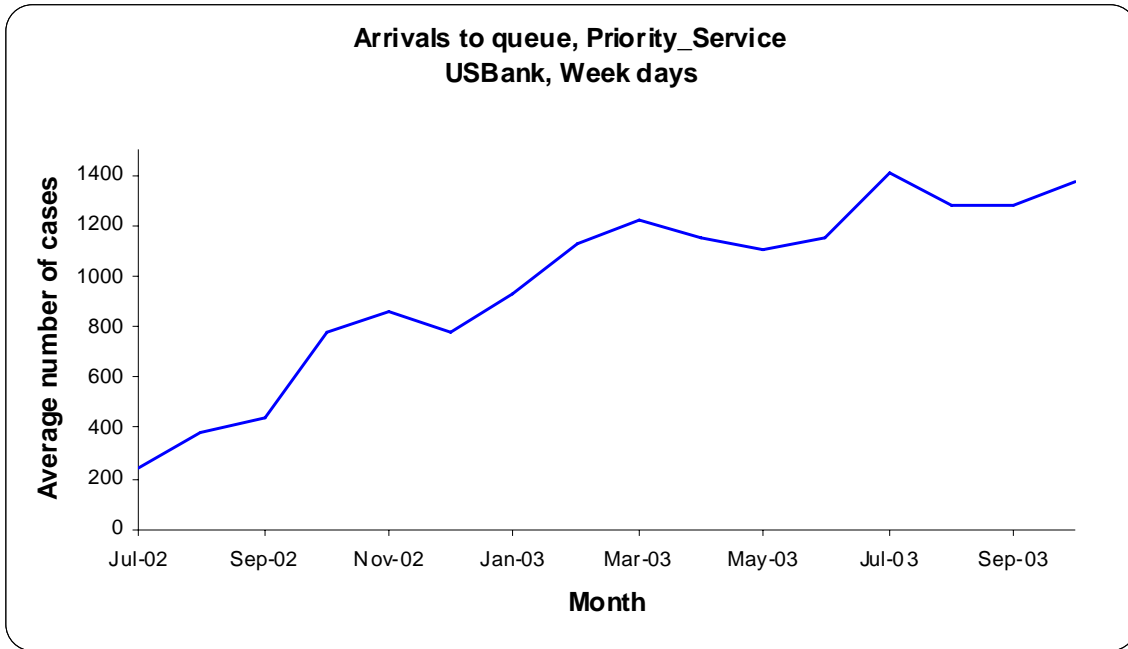


In the following graph we see a peak on August 2002 in the abandonment rate of the Priority Service calls, on December 2002 in the Quick Reilly calls and on October 2003 in the BPS calls. Furthermore, we do not see peaks of abandonment for existing service types, which indicates that the addition of new services did not influence the service level of the existing services types, which is comforting.



## “Priority Service” Analysis Explaining Peak Abandonment in August 2002

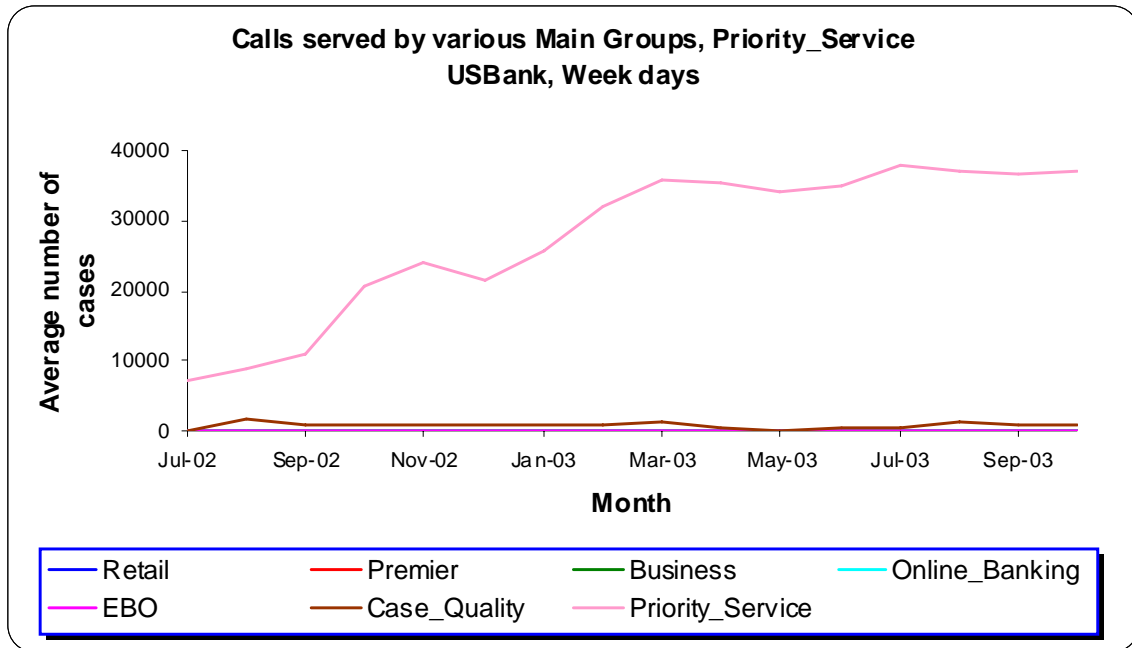
In the next two graphs, we see that on August 2002 the number of Priority Service calls increases by 59% relative to July 2002, whereas the total-work-time<sup>4</sup> of “Priority Service” agents increases by only 25% relative to July 2002.



<sup>4</sup>Total-work-time is defined to be the amount of work that the agents allocate to the system during a time-unit. (Here, work is measured in time-units of service.) This is a notion that parallels that of the *offered-load*, but the latter corresponds to work that arrives via the customers. In the above graphs, total work-time is measured by work-hours per day.



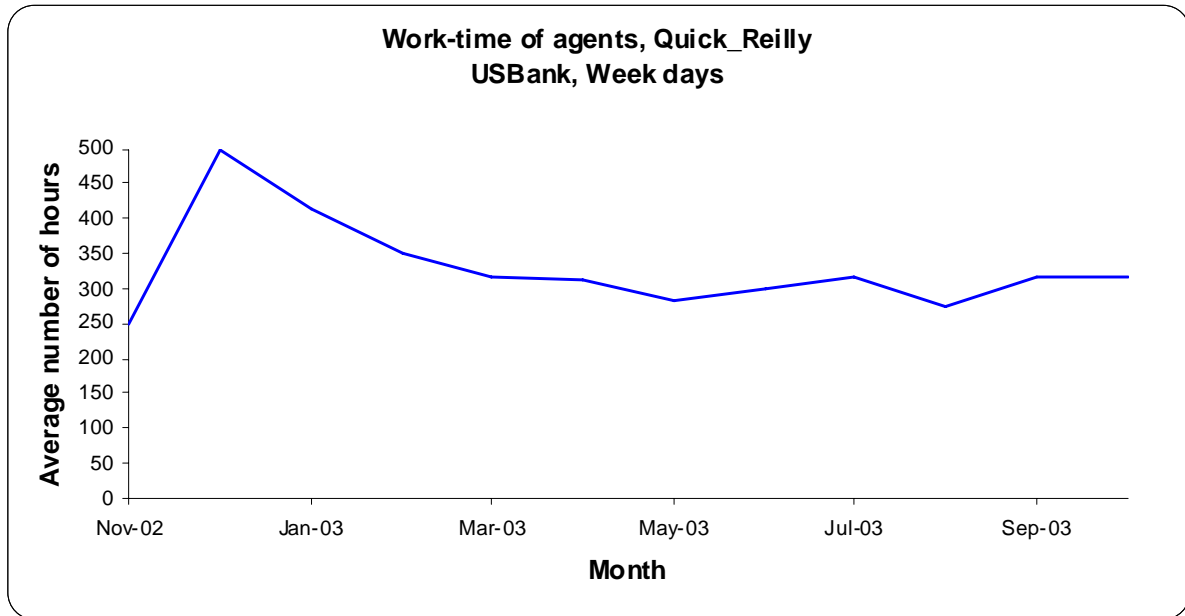
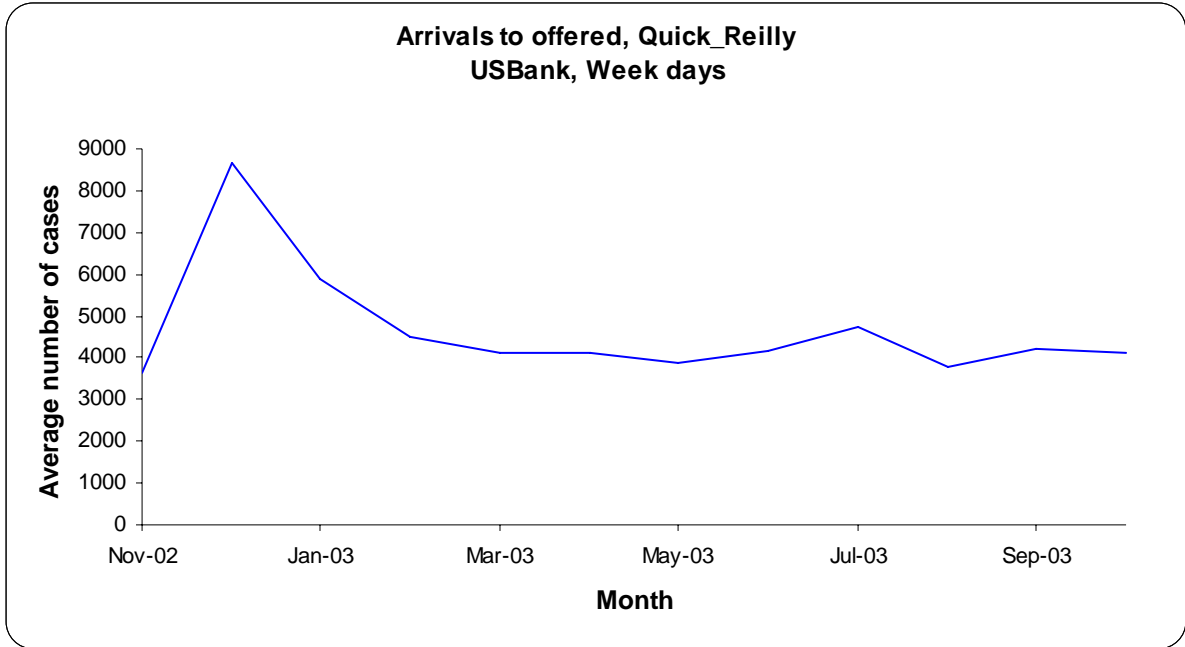
In the next graph we see that the majority of Priority Service calls are handled by Priority Service agent (agents whose main service group is Priority Service), but in some cases, the Case Quality agents serve some calls as well. Going back to the abandons graph (page 6) we see that that in August 2002, which is the peak of Priority Service abandoned calls, is also the peak of calls served by Case Quality agents. But, in the abandons graph we see that the Case Quality calls in fact have a relatively large abandon rate themselves. This fact can be the explanation for why Case Quality agents do not serve more Priority Service calls.



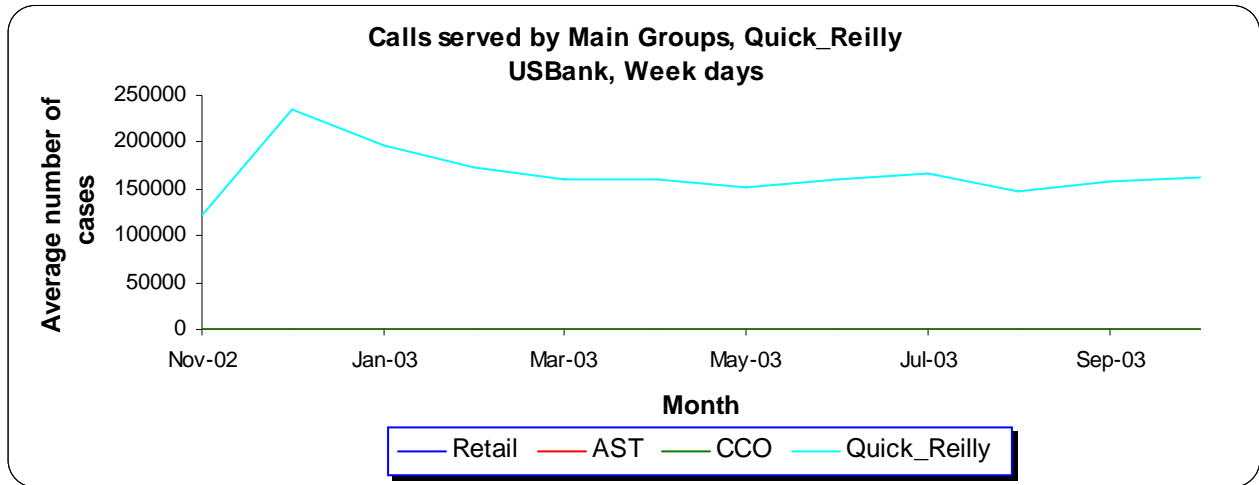
We identified two principal reasons that lead to the peak of abandoning calls in August 2002: First, a significant growth in the Priority Service calls, with an insufficient growth in the Priority Service agents work time; Second, the fact that the unique other group of agents that can help with Priority Service calls, the Case Quality agents group, had a bad service level during this period as well. Further analysis of Priority Service calls reveals that the higher the load the more they are served by Case Quality agents; but the help is typically insufficient to guarantee an acceptable service level for Priority Services.

## “Quick\_Reilly” Analysis Explaining Peak Abandonment in December 2002

In the next two graphs, we see that in December 2002 the number of Quick Reilly calls increases by 143% relative to November 2002, whereas the total-work-time of “Quick Reilly” agents increases by 98% relative to November 2002.



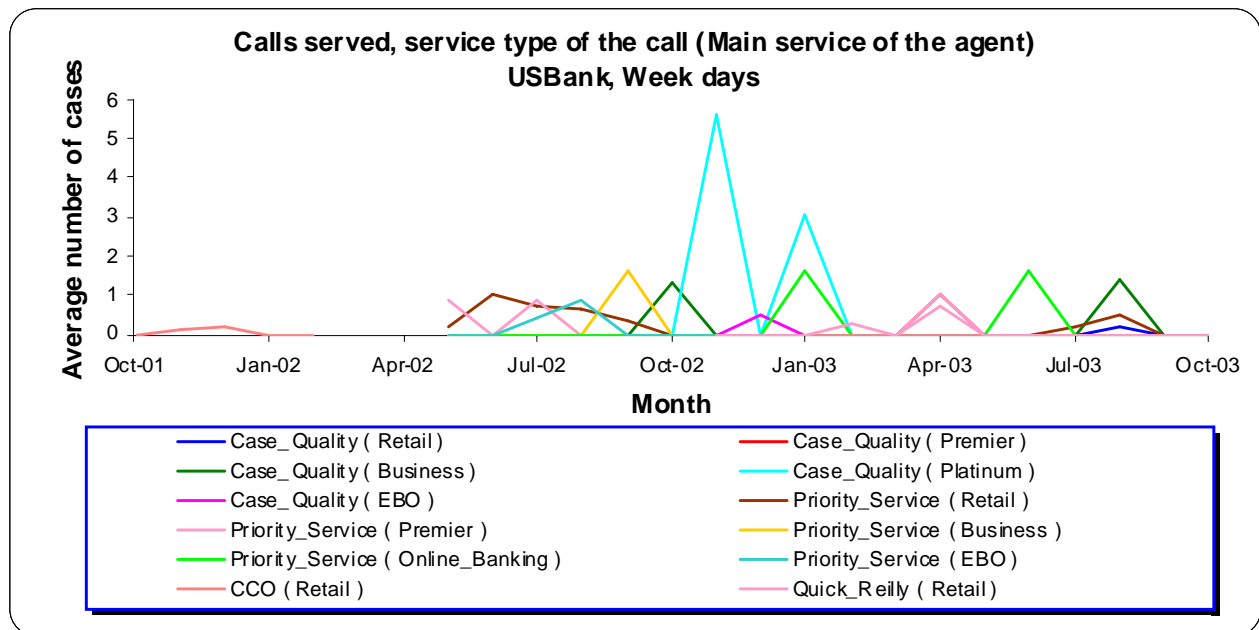
In the next graph we see that Quick Reilly calls are handled almost uniquely by Quick Reilly agent (agents whose main service group is Quick Reilly). In addition, we see that also some Retail, AST, CCO agents served a few number of Quick Reilly calls, but this number is negligible.



The conclusions from this analysis are that the peak of abandoning calls is the result of a large growth in the amount of the Quick Reilly calls, an insufficient increase in the agents work time and from the fact that these calls are served only by agents whose main group service is Quick Reilly.

### Effect on Existing Groups

In the next graph we see the number of calls coming from new services which were served by traditional service agents. We see that calls from the new services types are not reaching the traditional services agents. This is why the traditional service levels are not affected by the addition of new services.



## **Skills Groups Definitions**

### **Grouping**

Several factors influence the characterization of an agent's skills-set. Here we explain, via examples, the factors that we have been using.

When there are several types of calls served by an agent, one must decide if these types characterize a skill or, alternatively, they are random assignments due perhaps to random circumstances. (For example, an unforeseen increase in load that enforces unqualified agents to serve calls beyond their skill-set.)

Our grouping decisions are based on the different services types which the agents take, the percentage of the agent calls from each service type, the percentage of the service type calls that flows to each agent group, the agent skills characteristics over the different months and the number of agent with the same skills characteristics.

### **Grouping Examples, the May 2001 Case**

On May 2001, 1851 agents worked in the call center within 17 different skills-groups.

The largest group in May 2001 is Group 1, consisting of 575 agents. This group consists of all the agents that take mainly Retail service. In Table 2 we see that this group serves 36.26% of the Retail calls, and a very small percentage of others services. This small percentage is negligible because the number of calls is small and the number of agents is large, so it does not influence agents performance. (In Table 1 we see that this fraction is 0.01% of the agents calls). Still, the question arises whether these call types should affect the characterization of these agents' skills-set. To this end, we observe that, in later months, none of such call-types were served by these agents. Hence, we deduce that the service-types in question are not elements of these agents-skills-set.

There are 252 agents who serve mainly Retail group that form Group 2. The difference between this group and Group 1 is that the Group 2 agents take a small number of Premier, Business and Telesales calls, but in these cases we identify predictable patterns of those calls routing (in most of them, we see a small number of these service types calls to each agent on each month of the successive months).

The smallest group is Group 38, which is formed by only one agent. This one agent is very important because he or she serves 15.24% of the Subanco calls, and there are no others agents in the call center with the same skills characteristic.

### **Main Service**

Our Main Service decision is based on only two important parameters: the percentage of the agent calls from each service type and the percentage of the service type calls in each agent group.

### **Examples of Main Services, the May 2001 Case**

Group 12 is grouping 58 agents, who take 7.24% of the Retail calls; these 7.24% of the Retail calls represent 93.44% of those agents work, therefore the main service of this group is Retail service.

Group 31 is grouping 43 agents; 84.15% of their calls are Business calls and 15.62% are Platinum calls but, on the other hand, this group takes 39.5% of the Business calls and 95.51% of the Platinum calls.

This is the reason that the main service of this group is Platinum calls.

**Table 1** (Groups work description): group code, total number of agents, main service, total number of calls and the percentage of the agent calls from each service type.

Group Code	Total # Agents	Main Services	Retail	Premier	Business	Platinum	Customer Loans	Online Banking	EBO	Telesales	Subanco	Summit	Total # Calls
1	575	Retail (1)	99.97	0.01	0	0	0.01	0	0	0	0	0	254075
2	252	Retail (1)	97.38	0.3	1.67	0	0	0.06	0	0.59	0	0	205875
4	17	Retail (1)	69.06	19.62	5.79	0	0	0	0	5.53	0	0	6387
6	94	Retail (1)	98.62	0.25	0.9	0	0	0.01	0	0	0.22	0	86529
9	44	Retail (1)	96.53	0.19	0	0.15	0.01	3.12	0	0	0	0	36369
10	78	EBO (7)	66.99	0.35	0.62	0	0	0	31.93	0.11	0	0	55452
12	58	Retail (1)	93.99	0.17	1.26	0	0	0	0	4.58	0	0	53943
15	43	Retail (1)	98.73	0.14	0.12	0	0	0.01	0	0	1	0	24996
19	89	Premier (2)	0.68	99.29	0	0.03	0	0	0	0	0	0	40681
29	64	Business (3)	0.58	0	98.89	0.47	0	0.02	0	0.02	0.02	0	37705
31	43	Platinum (4)	0.23	0	84.15	15.62	0	0	0	0	0	0	33493
33	83	Customer Loans (5)	7.35	0	0	0	92.65	0	0	0	0	0	67803
34	6	Subanco (9)	0.02	0	0	0	68.67	0	0	0	31.31	0	5273
35	178	Online Banking (6)	8.67	0.23	0	0	0	91.1	0	0	0	0	35404
36	129	Telesales (8)	0	0	0	0	0	0	0	100	0	0	74765
38	1	Subanco (9)	0	0	38.15	0	0	0.16	0	0	61.69	0	616
45	97	Summit (14)	0	0	0	0	0	0	0	0	0	100	111948

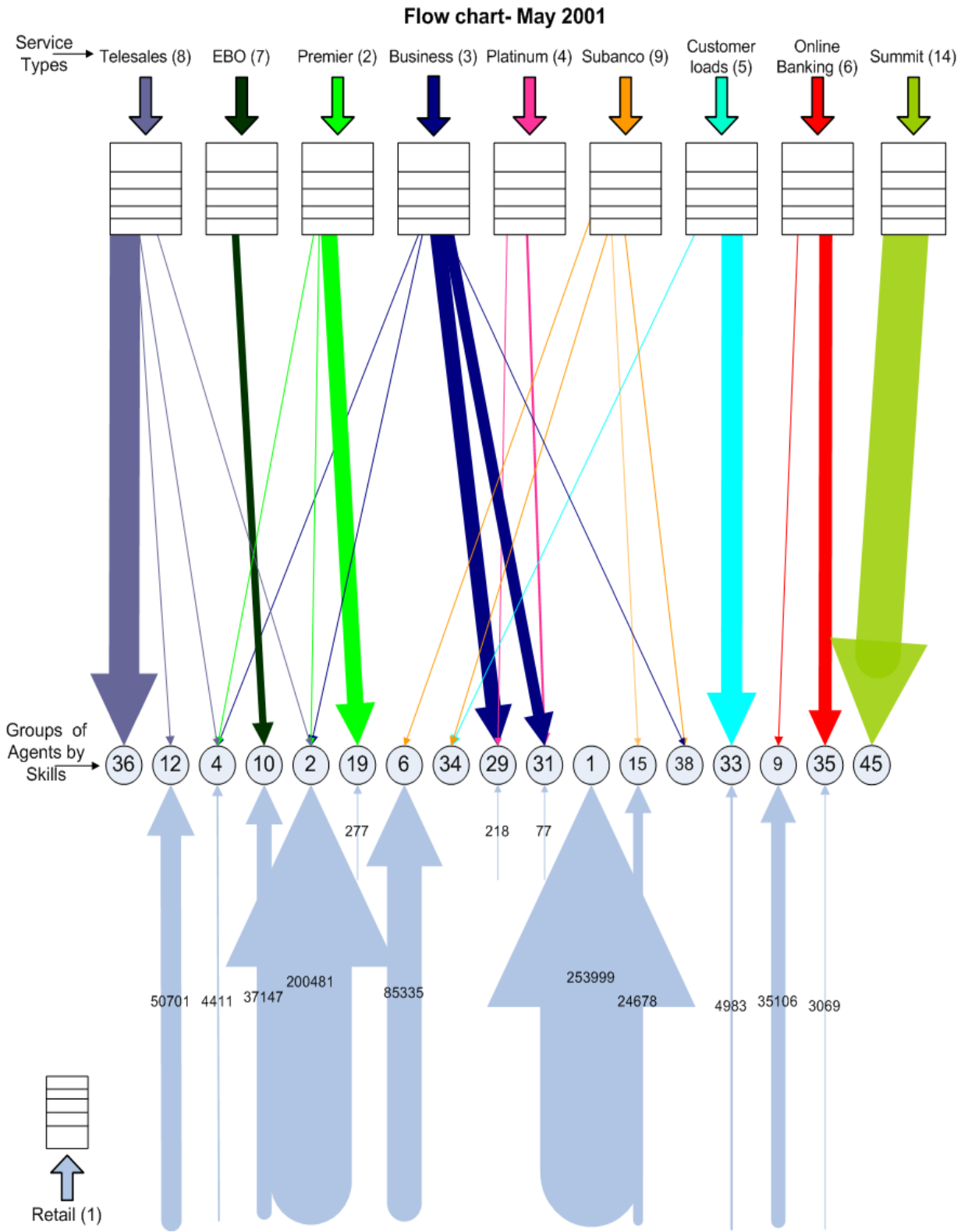
Note: Each row sums up 100%.

**Table 2** (Calls flow description): main service, group code, total number of agents, the percentage of the service type calls that flows to each agent group, and the number of calls arriving from each service.

Main services	Group Code	Total # Agents	Retail	Premier	Business	Platinum	Customer Loads	Online Banking	EBO	Telesales	Subanco	Summit
Retail (1)	1	575	36.26	0.07	0.01	0.02	0.03	0.01	0	0	0.16	0
Retail (1)	2	252	28.62	1.43	4.81	0	0.01	0.38	0.01	1.55	0.32	0
Retail (1)	4	17	0.63	2.92	0.52	0	0	0	0	0.45	0	0
Retail (1)	6	94	12.18	0.5	1.09	0	0	0.02	0	0	7.78	0
Retail (1)	9	44	5.01	0.16	0	0.99	0	3.39	0	0	0	0
EBO (7)	10	78	5.3	0.45	0.48	0.04	0	0	99.99	0.08	0	0
Retail (1)	12	58	7.24	0.21	0.96	0	0	0	0	3.13	0	0
Retail (1)	15	43	3.52	0.08	0.04	0	0	0.01	0	0	9.98	0
Premier (2)	19	89	0.04	93.99	0	0.22	0	0	0	0	0	0
Business (3)	29	64	0.03	0	52.26	3.23	0	0.02	0	0.01	0.28	0
Platinum (4)	31	43	0.01	0	39.5	95.51	0	0	0	0	0	0
Customer Loans (5)	33	83	0.71	0	0	0	94.51	0	0	0	0	0
Subanco (9)	34	6	0	0	0	0	5.45	0	0	0	66.2	0
Online Banking (6)	35	178	0.44	0.19	0	0	0	96.18	0	0	0.04	0
Telesales (8)	36	129	0	0	0	0	0	0	0	94.79	0	0
Subanco (9)	38	1	0	0	0.33	0	0	0	0	0	15.24	0
Summit (14)	45	97	0	0	0	0	0	0	0	0	0	100
		Total # Calls	700703	43282	72149	35068	71742	36810	55458	78874	7965	111948

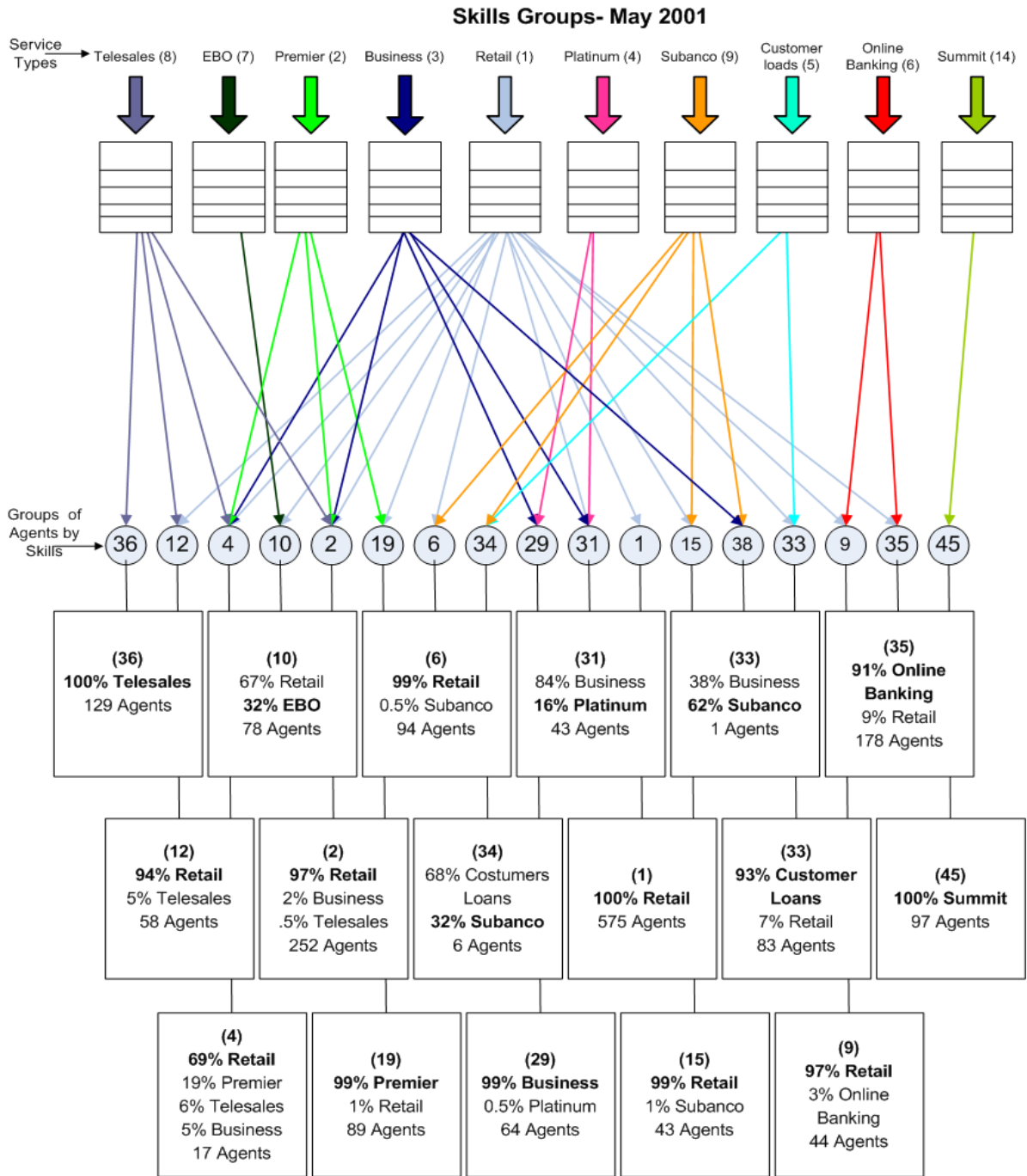
Note: Each column sums up 100%.

**Chart 1**



**Note:** The width of the arrows is proportional to the number of calls for all the arrows that represent more than 5000 calls. The width of all the arrows that represent less than 5000 calls is equal.

**Chart 2**



**Note (1):** The hold Service Type in each Skill-Group represents the Main-Service.

**Note (2):** The above codes of groups-of-agents-by-skills are part of a list of 48 codes, which we have produced for the whole period of our analysis. In the above chart we describe only the codes relevant to May 2001. The full list appears in the SBR manual, which is under preparation.

## Appendix 1: May 2002 Data

**Table 3** (Groups work description): group code, total number of agents, main service, total number of calls and the percentage of the agent calls from each service type.

Group Code	Total # Agents	Main Services	Retail	Premier	Business	Platinum	Customer Loans	Online Banking	EBO	Telesales	Subanco	Priority Service	Total # Calls
1	500	Retail (1)	99.87	0	0	0.01	0.08	0	0	0.02	0.01	0	411764
5	273	Retail (1)	98.77	0.14	1.07	0.01	0	0	0	0	0	0	346671
10	92	EBO (7)	77.63	0.11	0.49	0	0	0	21.76	0	0	0	93279
16	25	Subanco (9)	70.78	0.27	0.11	0.01	0.02	0	0	0	28.81	0	19171
19	40	Premier (2)	7.28	92.72	0	0	0	0	0	0	0	0	27624
23	33	Premier (2)	20.76	77.2	0	0	2.04	0	0	0	0	0	19972
28	33	Business (3)	18.85	0	81.13	0.02	0	0	0	0	0	0	32242
30	30	Business (3)	9.53	0	88.31	1.74	0	0	0	0.42	0	0	32885
32	29	Platinum (4)	4.52	0	76.1	19.38	0	0	0	0	0	0	29435
33	90	Customer Loans (5)	16.05	0	0	0	83.95	0	0	0	0.01	0	93759
35	130	Online Banking (6)	28.71	0	0	0	0	71.29	0	0	0	0	61715
36	144	Telesales (8)	0	0	0	0	0	0	0	100	0	0	82636
42	50	Priority Service (11)	0	0	0	0	0	0	0	0	0	100	479

Note: Each row sums up 100%.

**Table 4** (Calls flow description): main service, group code, total number of agents, the percentage of the service type calls that flows to each agent group, and the number of calls arriving from each service.

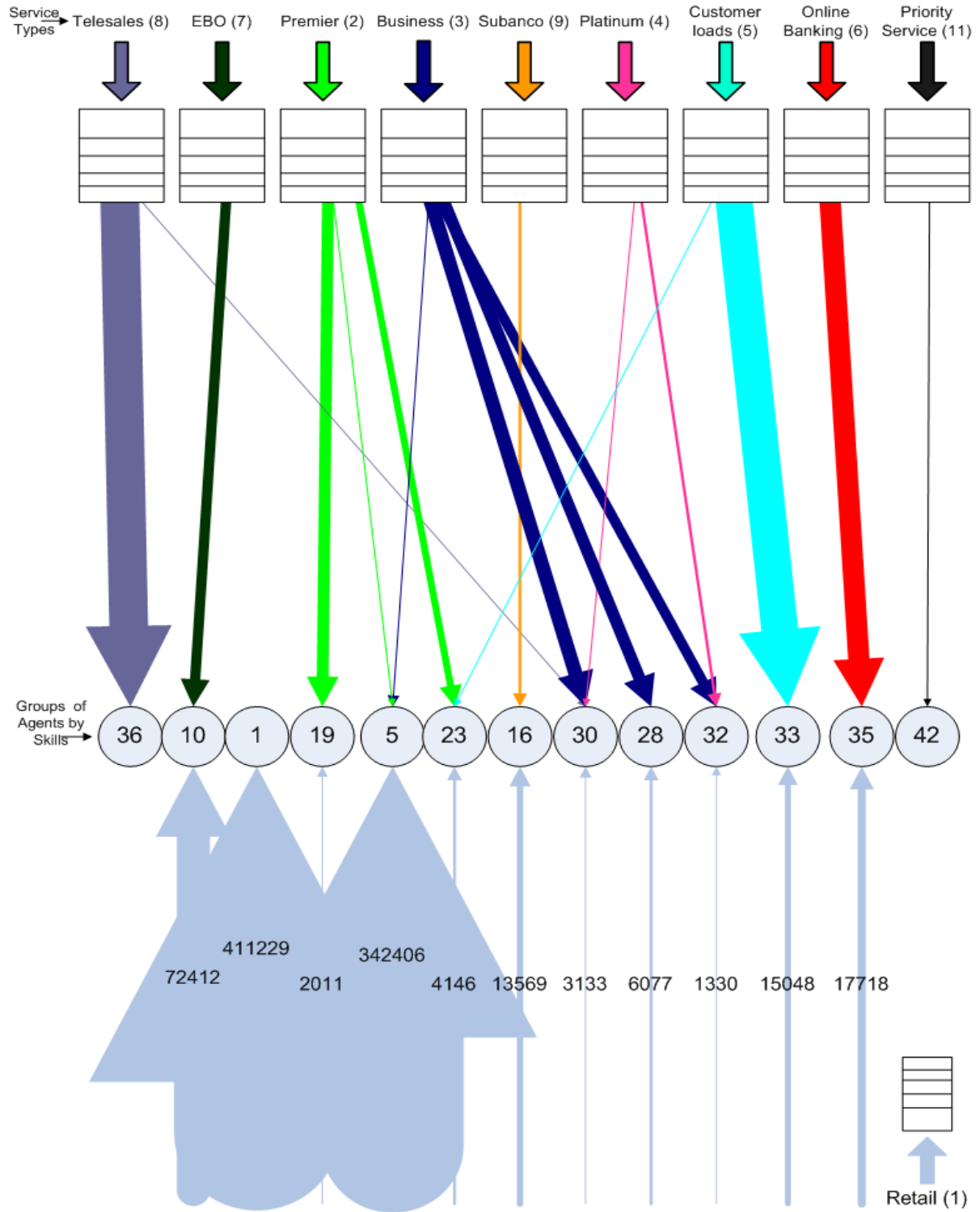
Main Groups	Group Code	Total # Agents	Retail	Premier	Business	Platinum	Customer Loads	Online Banking	EBO	Telesales	Subanco	Priority Service
Retail (1)	1	500	46.25	0.04	0.01	0.53	0.43	0	0	0.09	0.65	0
Retail (1)	5	273	38.51	1.14	4.55	0.71	0	0	0	0	0.09	0
EBO (7)	10	92	8.14	0.26	0.56	0.03	0	0	99.99	0	0	0
Subanco (9)	16	25	1.53	0.12	0.03	0.02	0.01	0	0	0	99.17	0
Premier (2)	19	40	0.23	61.45	0	0	0	0	0	0	0	0
Premier (2)	23	33	0.47	36.99	0	0	0.51	0	0	0	0	0
Business (3)	28	33	0.68	0	31.97	0.08	0	0	0	0	0	0
Business (3)	30	30	0.35	0	35.5	9	0	0	0	0.17	0	0
Platinum (4)	32	29	0.15	0	27.38	89.63	0	0	0	0	0	0
Customer Loans (5)	33	90	1.69	0	0	0	99.06	0	0	0	0.09	0
Online Banking (6)	35	130	1.99	0	0	0	0	100	0	0	0	0
Telesales (8)	36	144	0	0	0	0	0	0	0	99.74	0	0
Priority Service (11)	42	50	0	0	0	0	0	0	0	0	0	100
		Total # Calls	890301	44954	100851	32841	94649	61715	93288	82851	19331	479

Note: Each column sums up 100%.



**Chart 3**

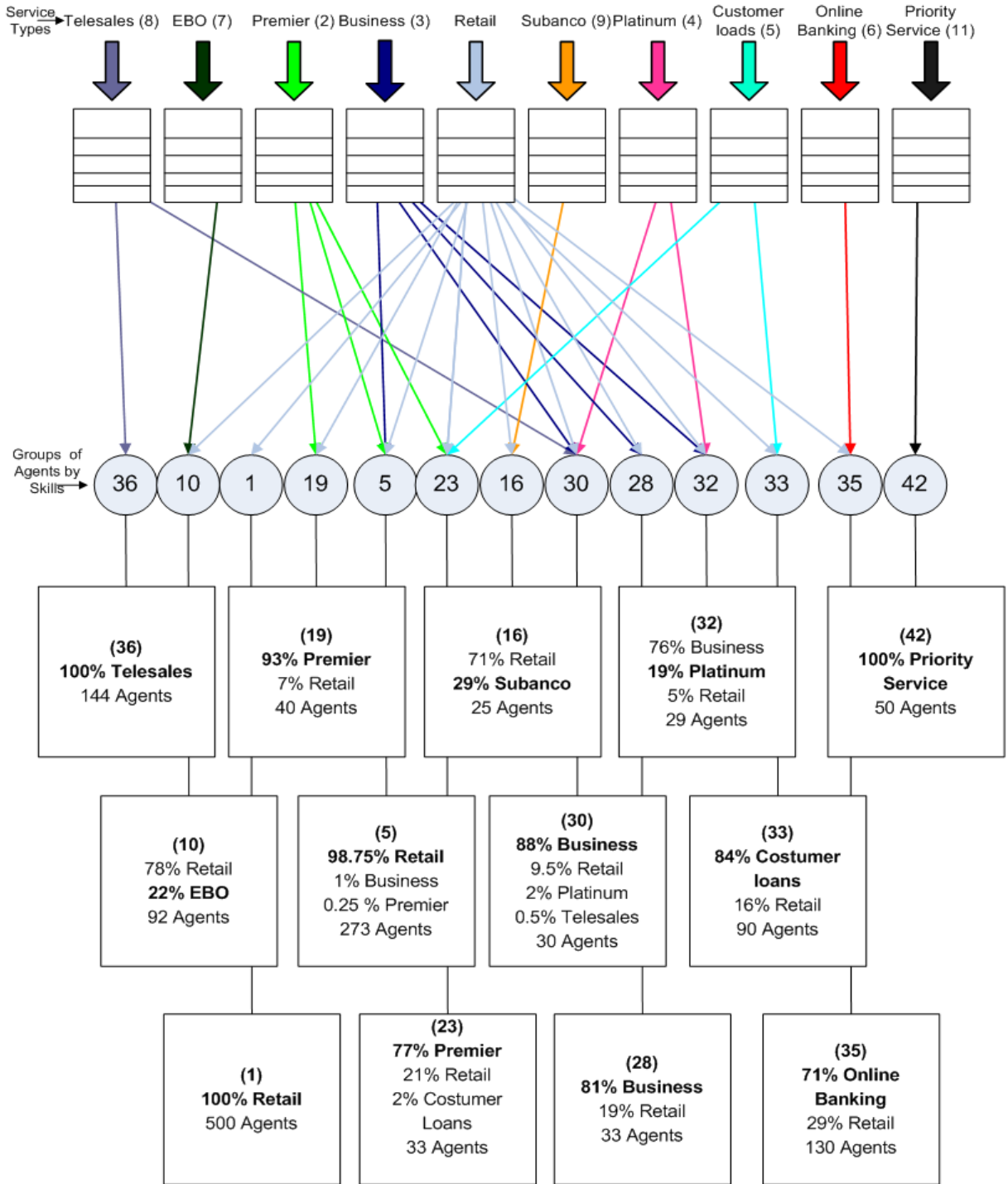
**Flow chart- May 2002**



**Note:** The width of the arrows is proportional to the number of calls for all the arrows that represent more than 5000 calls. The width of all the arrows that represent less than 5000 calls is equal.

**Chart 4**

**Skills Groups - May 2002**



**Note (1):** The hold Service Type in each Skill-Group represents the Main-Service.

**Note (2):** The above codes of groups-of-agents-by-skills are part of a list of 48 codes, which we have produced for the whole period of our analysis. In the above chart we describe only the codes relevant to May 2001. The full list appears in the SBR manual, which is under preparation.

## Appendix 2: May 2003 Data

**Table 5 (Groups work description):** group code, total number of agents, main service, total number of calls and the percentage of the agent calls from each service type.

Code	Total # Agents	Main Groups	Retail	Premier	Business	Platinum	Customer Loads	Online Banking	EBO	Telesales	Subanco	Case Quality	Priority Service	AST	CCO	Quick&Reilly	BPS	Total # Calls
1	233	Retail (1)	99.86	0	0	0	0	0	0.14	0	0	0	0	0	0	0	0	194159
5	400	Retail (1)	99	0.25	0.74	0.01	0	0	0	0	0	0	0	0	0	0	0	480607
10	72	EBO (7)	68.7	0.22	1.12	0	0	0	29.96	0	0	0	0	0	0	0	0	74971
16	34	Subanco (9)	80.7	0.3	0	0	0	0	1.12	0.03	17.86	0	0	0	0	0	0	40442
20	70	Premier (2)	12.58	87.06	0.16	0	0.19	0	0	0	0	0	0	0	0	0	0	55955
28	40	Business (3)	9.01	0	90.99	0	0	0	0	0	0	0	0	0	0	0	0	30606
30	27	Business (3)	11.1	0	84.06	3.9	0	0	0	0.95	0	0	0	0	0	0	0	27573
32	18	Platinum (4)	8.06	0	74.48	17.46	0	0	0	0	0	0	0	0	0	0	0	19951
33	100	Customer Loans (5)	6.19	0	0	0	93.79	0	0	0	0.02	0	0	0	0	0	0	104801
35	122	Online Banking (6)	4.32	0	0.2	0	0	95.48	0	0	0	0	0	0	0	0	0	47449
36	136	Telesales (8)	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	88790
40	31	Case Quality (10)	0	0	0	0	0	0	0	0	0	98.73	1.27	0	0	0	0	10036
42	82	Priority Service (11)	0.01	0	0	0	0.01	0.01	0	0	0	3.17	96.81	0	0	0	0	18270
43	68	AST (12)	0	0	0	0	0	0	0	0	0	0	0	100	0	0	0	47755
44	136	CCO (13)	0	0	0	0	0	0	0	0	0	0	0	0	100	0	0	116188
46	152	Quick&Reilly (15)	0	0	0	0	0	0	0	0	0	0	0	0	0	100	0	61973
48	19	BPS (17)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	8855

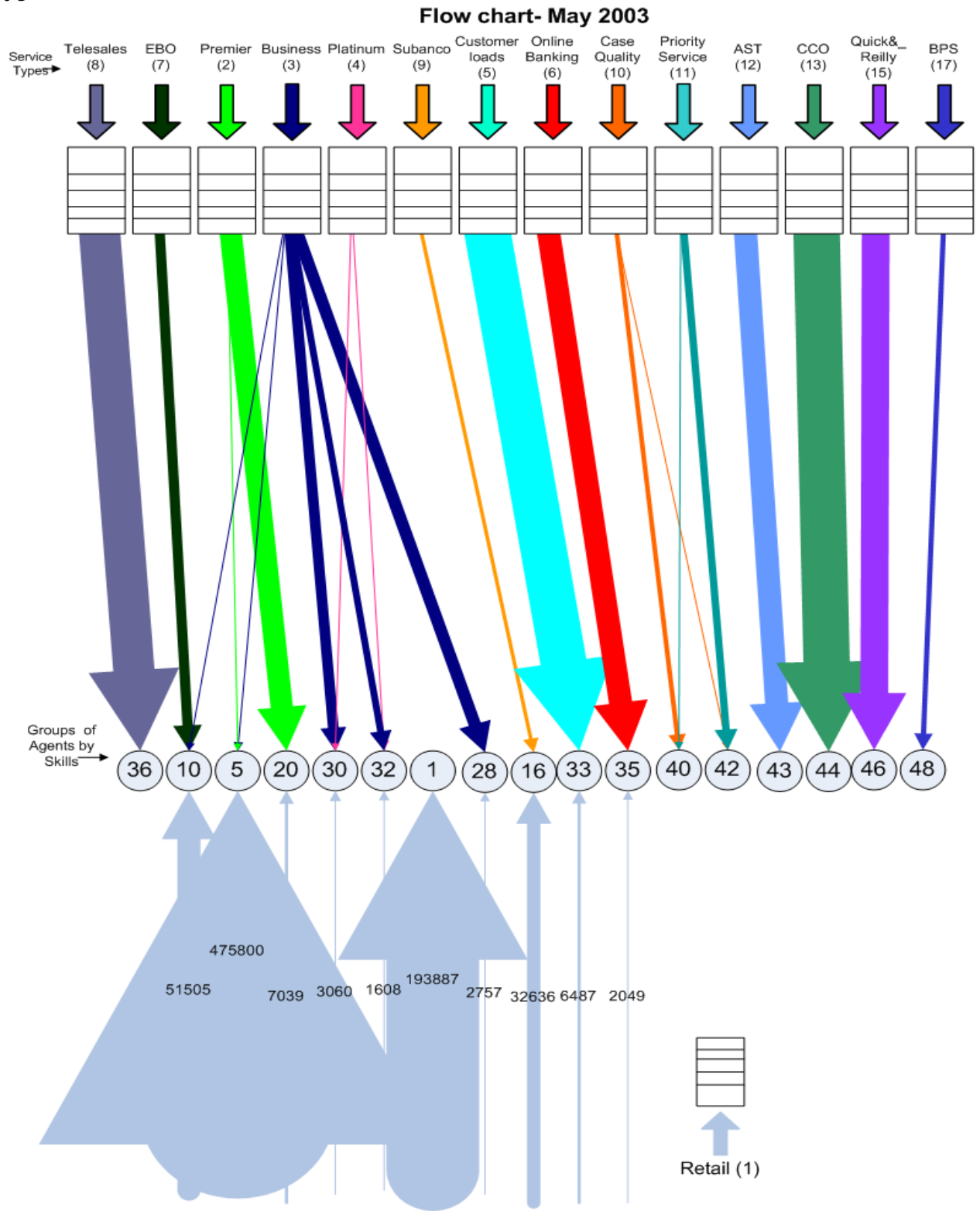
Note: Each row sums up 100%.

**Table 6 (Calls flow description):** main service, group code, total number of agents, the percentage of the service type calls that flows to each agent group, and the number of calls arriving from each service.

Main Groups	Code	Total # Agents	Retail	Premier	Business	Platinum	Customer Loads	Online Banking	EBO	Telesales	Subanco	Case Quality	Priority Service	AST	CCO	Quick&Reilly	BPS
Retail (1)	1	233	24.96	0	0	0	0	0	1.21	0	0	0	0	0	0	0	0
Retail (1)	5	400	61.25	2.43	5.02	1.53	0	0	0	0	0	0	0	0	0	0	0
EBO (7)	10	72	6.63	0.33	1.19	0	0	96.84	0	0	0	0	0	0	0	0	0
Subanco (9)	16	34	4.2	0.24	0	0	0	1.95	0.01	99.72	0	0	0	0	0	0	0
Premier (2)	20	70	0.91	96.99	0.13	0	0.11	0	0	0	0	0	0	0	0	0	0
Business (3)	28	40	0.35	0	39.53	0	0	0	0	0	0	0	0	0	0	0	0
Business (3)	30	27	0.39	0	32.9	23.21	0	0	0.29	0	0	0	0	0	0	0	0
Platinum (4)	32	18	0.21	0	21.09	75.26	0	0	0	0	0	0	0	0	0	0	0
Customer Loans (5)	33	100	0.84	0	0	0	99.89	0	0	0.28	0	0	0	0	0	0	0
Online Banking (6)	35	122	0.26	0	0.13	0	0	99.99	0	0	0	0	0	0	0	0	0
Telesales (8)	36	136	0	0	0	0	0	0	99.69	0	0	0	0	0	0	0	0
Case Quality (10)	40	31	0	0	0	0	0	0	0	0	94.48	0.71	0	0	0	0	0
Priority Service (11)	42	82	0	0	0	0	0	0	0	0	5.52	99.29	0	0	0	0	0
AST (12)	43	68	0	0	0	0	0	0	0	0	0	0	100	0	0	0	0
CCO (13)	44	136	0	0	0	0	0	0	0	0	0	0	0	100	0	0	0
Quick&Reilly (15)	46	152	0	0	0	0	0	0	0	0	0	0	0	0	100	0	0
BPS (17)	48	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
		Total # Calls	777881	57692	77425	26509	104916	47454	77417	89066	40556	10622	18401	47755	116188	61973	8855

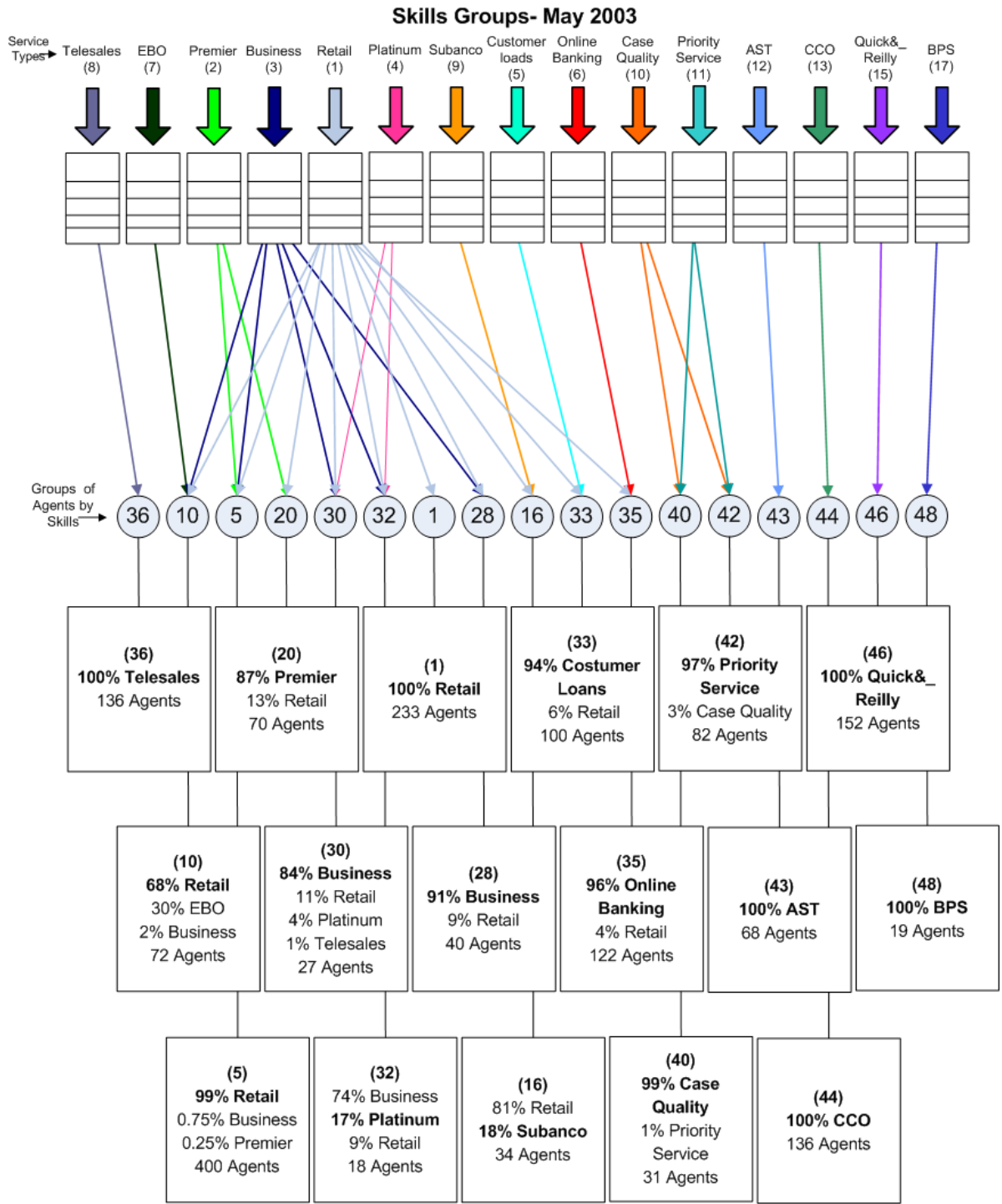
Note: Each column sums up 100%.

Chart 5



**Note:** The width of the arrows is proportional to the number of calls for all the arrows that represent more than 5000 calls. The width of all the arrows that represent less than 5000 calls is equal.

**Chart 6**



**Note (1):** The hold Service Type in each Skill-Group represents the Main-Service.

**Note (2):** The above codes of groups-of-agents-by-skills are part of a list of 48 codes, which we have produced for the whole period of our analysis. In the above chart we describe only the codes relevant to May 2001. The full list appears in the SBR manual, which is under preparation.

### Appendix 3: Codes of Service Types

Code	Service
1	Retail
2	Premier
3	Business
4	Platinum
5	Customer Loans
6	Online Banking
7	EBO
8	Telesales
9	Subanco
10	Case Quality
11	Priority Service
12	AST
13	CCO
14	Summit
15	Quick&Reilly
16	Mortgage
17	BPS