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Studying Customer Behavior in the Libyan Telecoms Market using Data Visualization

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ABSTRACT

In general, the main benefit of data visualization is that it provides a better understanding of complex data and enables faster decision-making.This study on call detail records (CDRs) and SMS activity data visualization was conducted to fully understand the customer behavior patterns and culture in the Libyan telecom market.A big telecom data (261 GB) was collected for CDRs between 28 March and 22 April 2020. This includes 19 working days, three Fridays and four Saturdays. The data visualization results show that the weekend SMS and call activity pattern shows a completely different behavior compared to other days of the week. Call behavior between 12:00 and 7:00 is generally almost the same. The peak times for calls on weekdays are between 11:30 and 13:00 and for SMS between 19:30 and 22:00. Furthermore, the analysis of SMS activities does not reflect customer behavior, but much of the SMS activity is the result of electronic payment services during shopping. However, Libyan culture is more about making phone calls than sending SMS messages. since the number of calls at dawn is minimal, the number of SMS increased slightly at this time. In order to retain customers, decision makers should consider these results and develop appropriate plans and strategies. However, in order to reduce call congestion and increase efficiency, decision makers should set appropriate pricing during peak or pre-peak and post-peak hours to convert many customers before or after peak hours.Also, they should somehow encourage customers to use SMS instead of calls.

دراسة سلوك العملاء في سوق الاتصالات الليبي باستخدام العرض المرئي للبيانات

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الكلمات المفتاحية:
الثقافة وسلوك العملاء
البيانات الضخمة
تصور البيانات
سوق الاتصالات
الرسائل القصيرة

الملخص

تتمثل الفائدة الرئيسية لتصور البيانات، بصفة عامة، في أنها توفر فهمًا أفضل للبيانات المعقدة وتتيح اتخاذ القرار بشكل أسرع. تم إجراء هذه الدراسة حول سجلات تفاصيل المكالمات (CDRs) وتصور بيانات نشاط الرسائل القصيرة لفهم أنماط سلوك العملاء وثقافتهم في سوق الاتصالات الليبي بشكل كامل. تم جمع بيانات اتصالات كبيرة (261 جيجابايت) لسجلات تسجيل المكالمات في الفترة ما بين 28 مارس و22 أبريل 2020. ويشمل ذلك 19 يوم عمل، ثلاثة أيام جمعة وأربعة أيام سبت. تظهر نتائج تصور البيانات أن نمط نشاط الرسائل القصيرة والمكالمات في عطلة نهاية الأسبوع يظهر سلوكًا مختلفًا تمامًا مقارنة بالأيام الأخرى من الأسبوع. سلوك المكالمات بين الساعة 12:00 و7:00 هو نفسه تقريبًا بشكل عام. كما أن أوقات الذروة للمكالمات خلال أيام الأسبوع بين الساعة 11:30 و13:00 وللرسائل القصيرة بين الساعة 19:30 و22:00. علاوة على ذلك، فإن تحليل أنشطة الرسائل القصيرة لا يعكس سلوك العملاء، ولكن الكثير من أنشطة الرسائل كانت نتيجة لخدمات الدفع الإلكتروني خلال التسوق. ومع ذلك، فإن الثقافة الليبية تدور حول إجراء المكالمات الهاتفية أكثر من إرسال الرسائل القصيرة. نظرًا لأن عدد المكالمات عند الفجر ضئيل، فقد زاد عدد الرسائل القصيرة قليلاً في هذا الوقت. هذا، ولأجل الاحتفاظ بالعملاء، يجب على متخذي القرار النظر في هذه النتائج ووضع الخطط

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والاستراتيجيات المناسبة. ومع ذلك، من أجل تقليل ازدحام المكالمات وزيادة الكفاءة، يجب على صانعي القرار تحديد الأسعار المناسبة خلال ساعات الذروة أو ما قبل الذروة وما بعد الذروة لتحويل عدد من العملاء قبل أو بعد ساعات الذروة. كما يجب عليهم أيضًا تشجيع العملاء بطريقة أو بأخرى على استخدام الرسائل القصيرة بدلاً من المكالمات.

Introduction

Big data is usually the fuel that, when used at its best, can propel an entire industry toward higher revenue and better customer service. Telecom companies are now realizing that big data, which is mostly ignored or underutilized, actually has huge financial potential. Precise, timely and comprehensive telecom big data analysis based on artificial intelligence tools and data visualization (DV) techniques to create more personalized service offers thanks to appropriate customer segmentation and research into customer behavior and experiences. With the expansion of telecom service providers, customer loyalty decreases, and if the customer chooses to remain loyal to a particular company, he requests that this loyalty be recognized and be rewarded. Using loyalty strategies is a very effective way to retain customers in this industry and an ideal way to encourage customer engagement and loyalty. Therefore, it is necessary to understand the customer's behavior, the method and tools he uses in his final decisions. This includes focusing on their activities, engagement patterns, use or disposal of certain products or services, and mental, emotional and behavioral responses to these actions. In this study, we used DV to fully understand customer behavior patterns and culture in the telecom market, and segment customers based on their activity to implement a complete marketing plan and strategy. However, DV is an essential tool for data scientists and data analysts. It enables researchers to make sense of their data and communicate their ideas to others, as well as gain insight into shopping trends, common behaviors and customer wish lists. Thus, big data and DV are becoming increasingly important for many researchers and in many fields. Many recent studies [1]-[11] have already applied DV to various aspects of human activity. It is an extremely important concept that needs to be considered in order to understand customer behavior [12]. Consequently, knowing the culture of the community helps to understand customer behavior, and when that behavior is repeated, it becomes a habit that they follow. Recently, significant research and contributions [13]-[17] have been made in the study of consumer behavior and its impact on purchase decisions.

In order to remain competitive and achieve financial advantages, it is essential for the telecoms industry to have a deep understanding of customer behavior, especially in the mobile sector [18]. According to the latest statistics, the number of smartphone subscriptions worldwide exceeds six billion and is predicted to increase by several hundred million more in the next few years [19]. In particular, the telecoms industry is regarded with large amounts of customer data that are utilized in a variety of ways. For example, customer data for churn prediction, customer acquisition and service personalization, and analyzes of mobile user characteristics to develop different customer segments [20]. Gorodov&Gubarev [21] described the main problems of big data visualization and approaches to avoid them. They also provided a classification of big data visualization methods based on their applicability to one of the three big data classes. They show that the majority of data visualization methods usually do not appear out of nowhere, but instead become a further development of previously existing methods. Analytical tools must meet the following requirements: 1) analyst should be able to use more than one data representation view at once; 2) active interaction between user and analyzable view; 3) dynamical change of factors number during working process with view.

Therefore, data visualization offers an accessible way to view and understand trends, outliers, and patterns in data. This study used information from call detail records (CDRs) obtained from Al-Madar Al-Jadeed company. A 250 randomized survey conducted in order to firmly understand the behavioral pattern of customers and analyze the market to implement the overall marketing plan and strategy.

It is worth noting that this study addressed three main benefits of using data visualization: to explore, to monitor, and to explain.The remainder of this paper includes the exploration of CDRs data, graphical visualization of call and SMS activity, followed by Storytelling about observable and cultural behavior in the Libyan telecom market, followed by the presentation of findings to inform decision making, and the conclusion.

Call Detail Records (CDRs) Data Exploration

CDRs are records of data produced by a telephone exchange or other telecoms equipment that document the details of a telephone call or text message (SMS) passing through that facility or device. The record contains various attributes of the call, such as time, duration, end status, source number, and destination number. All mobile phone calls are recorded in a suitable CDR file. It may contain information used by the mobile network operator to identify subscribers, call charges, services provided and call routing, etc. The CDR may contain; the start time of the call (date and time), the duration of the call, the additional digits of the called number that belong to the call forwarding or termination, layout or result of the call, marked, call type (voice, SMS, etc.), the location of the caller's cell tower and the recipient's cell tower.

AlmadarAljadidcompany is the first mobile network provider to enter the Libyan market. This company is a state-owned mobile network operator and data provider based in Tripoli and founded in 1995. They generate 1,275 call detail files per day, averaging 11 GB per day. However, the data collection for this study was substantial, 261 GB in size between March 28 and April 22, 2020 (26 days). It includes 19 working days, three Fridays and four Saturdays. Figure 1 illustrates the CDR analysis procedure. The Figure shows that the number of calls is lower on some days and higher on other days, which may correspond to some important events. In addition, SMS activity appears to be through value-added services and marketing campaigns that include banking messages and advertising messages that follow the market crowd method. These data influence the SMS curve to capture different trends, so we defined these data as outliers. The chart shows that the number of records is higher in these periods, from 28 March to 31 March, due to SMS awareness of the coronavirus (COVID-19) and increasing e-payment messages, where most customers in the country electronic payment services due to the liquidity crisis. On March 28, an additional set of precautionary COVID-19 measures was introduced, including an increase of the curfew time to be from 2 pm until 7 am. Thus, traditional shopping habits have been disrupted across the country as customer behavior in grocery stores has changed. Many customers buy and increase their purchases differently to meet their future needs in preparation for a possible curfew. Though, in the data analysis, those data points were considered as an outlier due to unusual SMS events. However, due to the liquidity crisis since 2016, most of the customers were switching to e-payment. E-payment service companies include but are not limited to Moamalat, Tadawul, Sadad, Edfali, Tadawul, and MobiCash. These companies send an SMS about the deducted amount with every purchase.

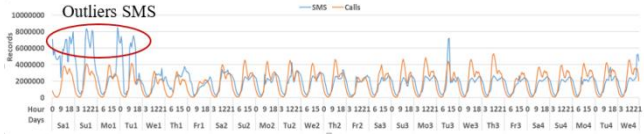

Fig. 1: CDRs between March 28 and April 22, 2020

After excluding outliers in the Figure 1, we can conclude that SMS and call curves show recurring trends, except on Tuesday, April 14, 2020. We explained this phenomenon due to some security circumstances that occurred on this day in the cities of Sorman and Sabratha, where government control over these cities was restored. This may have led to an increase in texting for people to check and contact each other. Additionally, the government announced on April 14, 2020 that the country placed under a 24hr curfew for 10 days, starting on 17 April 2020. Only small neighborhood grocery shops and bakeries will remain open. it might be the expansion of e-payment methods and services, which require SMS text messages whenever a payment transaction takes place. For a deep investigation, we analyzed the activity of each day separately. The collected data contains Four Sundays, Four Tuesdays, Four Wednesdays, and Three Thursdays. The following insight illustrates the calls and SMS activity behavior for each hour on different days to give an overview of behavior patterns of the working days in the Libyan community

Call Activity Data Visualization (Storytelling)

Data visualization and storytelling are essential skills for data scientists who want to effectively communicate their insights and recommendations. Figure 2 shows the workday call activity. It is quite clear that the daily call trends are almost always repeated for the same day, but the value of recorded calls varies. Trends in call activity are almost the same, except for weekends (Saturdays and Fridays). On weekends, the morning call curve is less concave. However, on Friday, the curve is the least concave. However, the call activity on Friday morning is in contrast to the rest of the week, with the least morning activity but increasing in the evenings. Furthermore, the Sunday evening activity trend appears to be shifting to the right, in contrast to the rest of the week.

Use data analytics to continuously monitor and manage service performance degradation, model customer behavior, and map future needs. By accurately analyzing data points and usage patterns, it helps you understand customer preferences and identify important issues such as peaks and troughs. However, Table 1 displays the timing of peaks and troughs together with the average call activity for each day during these peaks and troughs. Sunday is the only day when the morning peak is at one o'clock in the afternoon, while the other days are at 12 o'clock. Friday is the only day when evening calls are more than morning calls. In general, the call activity on weekdays is almost the same, with peak call activity in the morning almost equal to 4 million calls. That value dropped to almost 3 million during the evening peak hours (the number of calls is reduced by 25%). If we vary these call activities to a percentage, over the weekend (Friday and Saturday) we found that call activity drops by 18%.

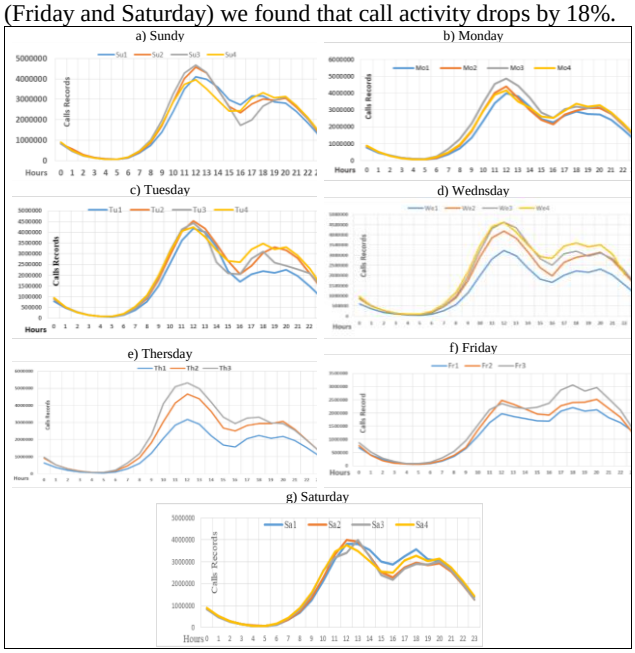

Fig. 2: Weekdays Call Activity

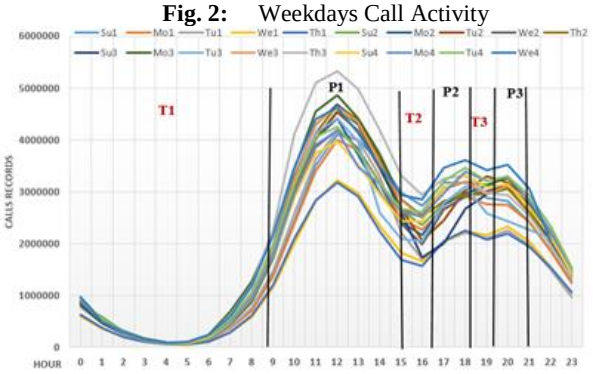

Fig. 3: Hourly Calls Activity Per Working Days

Table 1:Peaks and Troughs Along with Average Call Activity for Each Day.

		Average Values					
		P1	P1	P1	T1	T2	T3
Sa	Hour	01:00 pm	6:00 pm	8:00 pm	4:00 am	4:00 pm	7:00 pm
	CDR	3,720,239	3,039,759	3,020,202	85,641	2,322,672	2,916,956
Su	Hour	01:00 pm	6:00 pm	8:00 pm	4:00 am	4:00 pm	7:00 pm
	CDR	3,887,864	2,745,560	2,967,659	83,165	2,664,670	3,047,949
Mo	Hour	12:00 pm	6:00 pm	8:00 pm	4:00 am	4:00 pm	7:00 pm
	CDR	4,360,457	3,108,767	3,103,833	86,776	2,369,443	3,051,839
Tu	Hour	12:00 pm	6:00 pm	8:00 pm	4:00 am	4:00 pm	7:00 pm
	CDR	4,340,747	2,948,569	2,788,392	85,282	2,099,376	2,795,012
We	Hour	12:00 pm	6:00 pm	8:00 pm	4:00 am	4:00 pm	7:00 pm
	CDR	4,167,218	2,986,602	3,023,622	80,729	2,248,122	2,882,993
Th	Hour	12:00 pm	6:00 pm	8:00 pm	4:00 am	4:00 pm	7:00 pm
	CDR	4,389,773	2,831,608	2,732,829	77,872	2,337,873	2,664,205
Fr	Hour	12:00 pm	6:00 pm	8:00 pm	4:00 am	4:00 pm	7:00 pm
	CDR	2,269,645	2,559,582	2,541,247	76,615	1,989,777	2,440,982

Figure 4 demonstrations the weekly call activity percentage. Sunday call activity peaked at 16%, falling to 15% on Mondays, Tuesdays, Wednesdays and Thursdays, then falling again to 10% on Fridays and returning to 14% on Saturdays.

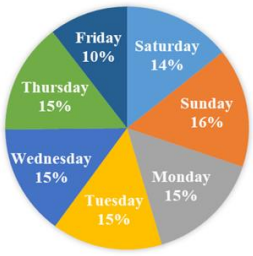

Fig. 4: Weekly Call Activity Percentage

Consequently, decision makers should consider these results and develop appropriate plans and strategies. However, in order to reduce

call congestion and increase efficiency, decision makers should set appropriate pricing during peak or pre-peak and post-peak hours to convert many customers before or after peak hours.

SMS Activity Data Visualization (Storytelling)

The SMS activity curve, as a storytelling, usually has two troughs for working days, as illustrated in Figure 5; the morning through is concave in the morning around five and six, while the evening trough is around four and five in the evening. In addition, this curve shows two peaks. First peak is convex around 12 and 1 pm, whereas second peak at almost 8pm. In contrast to call activity curves, SMS curves are less identical. It is quite clear that SMS activity starts with a concave trend and reaches a minimum activity every morning between five and six to make a first trough. The curve then moves up in a zigzag line to reach the morning peak time (first peak) between 12 and 1 p.m. The trend then decreases a little bit, bringing a small trough (second trough) around 4 pm and 5 p.m. Next, it goes up again to make the evening peak time between 8 am and 10 am (second peak). It is noteworthy that the SMS curves show a small pulse at seven in the morning, indicating a slight increase in the SMS activity. Besides, SMS activity behaves differently over the weekend, as the evening trough does not appear on the Friday curve, where activity continues to rise to reach the evening peak between 9 and 10 in the evening. In addition, the morning peak looks different from the rest of the week, appearing around 3 p.m. On the other hand, second trough is almost unclear on Saturday's SMS curve.

Table 2 shows the average SMS activity for the week. In contrast to call activity, the evening SMS peak shows greater activity than the morning peak. Friday shows the least SMS activity, but Saturday is almost similar to the other days.

As a result, in order to retain customers, decision makers should consider these results and develop appropriate plans and strategies. However, in order to reduce call congestion and increase efficiency, decision makers should somehow encourage customers to use SMS instead of calls.

Comparison; Call or SMS

Texting is an efficient, economical and popular means of information transfer that has replaced phone calls as the most popular method of information transfer in social circles. This is economically beneficial for people as the charges are lower than normal calls. SMS can sometimes be used as a reference when sending important information. Messages that cannot be conveyed verbally can simply be transmitted. The biggest advantage of SMS is that people are more likely to send accurate information because there is time to review the message before sending it [22]. It should be noted that messaging or text messaging does not fulfill the biological functions of vocal communication and face-to-face interactions. In terms of stress transmission and oxytocin release, texting is no substitute for spoken language. Additionally, People who are lonely in their lives prefer to talk and consider texting to be a less intimate form of communication, so anxious individuals prefer expressive and intimate communication [23].

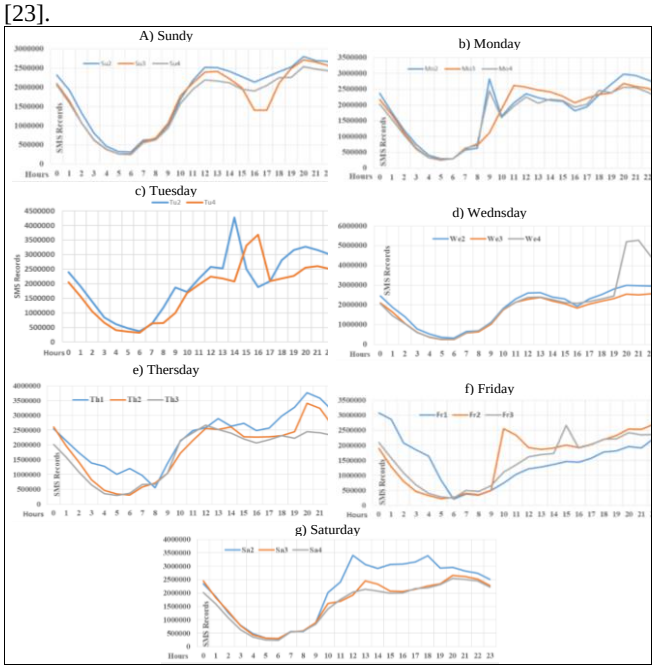

Fig. 5: Weekdays SMS Activity

Table2: Peaks and Troughs Along with Average SMS Activity for Each Day

		Average Values					
		P1	P1	P1	T1	T2	T3
Sa	Hour	01:00 pm	6:00 pm	8:00 pm	4:00 am	4:00 pm	7:00 pm
	CDR	3,720,239	3,039,759	3,020,202	85,641	2,322,672	2,916,956
Su	Hour	01:00 pm	6:00 pm	8:00 pm	4:00 am	4:00 pm	7:00 pm
	CDR	3,887,864	2,745,560	2,967,659	83,165	2,664,670	3,047,949
Mo	Hour	12:00 pm	6:00 pm	8:00 pm	4:00 am	4:00 pm	7:00 pm
	CDR	4,360,457	3,108,767	3,103,833	86,776	2,369,443	3,051,839
Tue	Hour	12:00 pm	6:00 pm	8:00 pm	4:00 am	4:00 pm	7:00 pm
	CDR	4,340,747	2,948,569	2,788,392	85,282	2,099,376	2,795,012
We	Hour	12:00 pm	6:00 pm	8:00 pm	4:00 am	4:00 pm	7:00 pm
	CDR	4,167,218	2,986,602	3,023,622	80,729	2,248,122	2,882,993
Th	Hour	12:00 pm	6:00 pm	8:00 pm	4:00 am	4:00 pm	7:00 pm
	CDR	4,389,773	2,831,608	2,732,829	77,872	2,337,873	2,664,205
Fr	Hour	12:00 pm	6:00 pm	8:00 pm	4:00 am	4:00 pm	7:00 pm
	CDR	2,269,645	2,559,582	2,541,247	76,615	1,989,777	2,440,982

As described above, much of the SMS activity does not reflect real personal communication but returns e-payment purchase messages. To establish the credibility of the Libyan culture regarding the use of SMS, a random online questionnaire of 243 participants responded to the use of SMS as opposed to a normal call. Figure 6 describes the questionnaire and the overall response. The majority of age groups are between 18 and 35 years old, accounting for 76.5% of the total sample. 69% of the total sample is female and 31% are male.

As expected, 63% of the total sample makes a phone call and does not send an SMS. Moreover, 65% of the total sample prefer to call on the weekend. As a cultural analysis and customer behavior, it is clear that as a culture, they would rather call than send an SMS. Therefore, the analysis of SMS activity does not reflect customer behavior and culture, but much of SMS activity is the result of e-payment services.

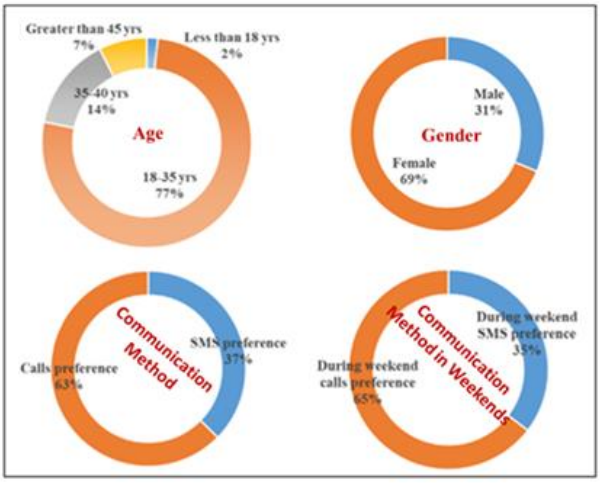

Fig. 6: Questionnaire Results

Libya has been suffering from a liquidity crisis for years, so the use of mobile banking and electronic payments has increased rapidly due to the lack of liquidity. The wide spread of mobile phones and the fact that a large percentage of the population has a bank account contributed to this. Thus, the majority of Libyans switched to e-payments. E-payment service companies include but are not limited to Moamalat, Tadawul, Sadad, Edfali, Tadawul, and MobiCash. These companies send an SMS about the deducted amount with every purchase.As a result, we would like to emphasize here again that the decision-makers in one way or another encourage users to use SMS instead of calling.

Conclusion

This study conducted data visualization to understand the culture and behavioral patterns of the Libyan community in the telecoms market. As a result, we found the following key points:

• Generally, the Libyan community prefers to call rather than text to get an immediate response. Short messages are sent at certain times, such as early morning or late evening, lunchtime, and bedtime.

• Call behavior between 12:00 and 7:00 is generally almost the same

• Call behavior on working days (Sunday to Thursday) is the same as the peak period between 11:30 and 13:00. and since the number of calls at dawn is minimal, the number of SMS increased slightly at this time.

• Even though Saturday is the weekend, it somehow follows the behavior of working days. The reason for this is that Saturday is a weekend only in public institutions, while the private sector considers it a normal working day.

• The peak is at 11:00 a.m. on Friday, which is before the Friday prayer, then the activity of mobile calls decreases and then increases again after the Asr prayer time.

• Mobile call activity has three peaks (12:30, 18:00 and 20:00) and three troughs (4:00, 16:00 and 19:00)

• The two peaks of SMS activity are around 5:30am and 12:30am, except Friday has one peak at 8am. In addition, two troughs for SMS. the 1st trough at 16:30, except on Saturdays at 19:00. while the 2nd trough is around 8pm, except on Fridays at 10pm.

• A survey was published for Libyans on Facebook to find out whether the best way to communicate is by calling or texting. We received answers from 243 people, the majority of respondents were between 18 and 35 years old. As expected, 63% of the total sample prefer calls and does not send SMS. In addition, 65% of the entire sample would rather call than text on weekends.

• In order to retain customers, AlmadarAljadidCompany should consider these results and develop appropriate plans and strategies, such as setting an appropriate price during peak hours to convert many customers before or after peak or pre-peak and post-peak hours to convert many customers before or after peak hours. Additionally, encourage customers to text instead of calls. This reduces call congestion and increases system efficiency.

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